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ABSTRACT

This document presents the transcript of a congressional hearing to consider the American Math and Science Student Support Act, H.R. 4595. The legislation is designed to address the issue of attracting a greater proportion of U.S. citizens to graduate study in science, mathematics, and engineering. The hearings include testimony and prepared statements from witnesses who have been asked to comment on the possible effects of the bill on increasing the participation of U.S. citizens in such graduate study. Witnesses include Dr. Jules LaPidus, President, Council of Graduate Schools, representing the Association of American Universities, Washington, D.C.; Dr. Frank Morris, Dean of Graduate Studies, Morgan State University, Baltimore, Maryland, and President, Council of Historically Black Graduate Schools; Dr. William Powers, Provost, Michigan Technological University, Houghton, Michigan; Dr. Stanford Penner, Professor of Applied Mechanics and Engineering Sciences, University of California, San Diego, California, and Chairman of the National Academy of Sciences Committee on the International Exchange and Movement of Engineers. Appendices include: Dr. Morris' address to the plenary session of the Council of Graduate Schools on Dec. 5, 1991; a letter from J. P. Densler to P. Henry; a statement from NAFSA Association of International Educators; and a statement from the National Association of State Universities and Land-Grant Colleges. (MDH)

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THE AMERICAN MATH AND SCIENCE STUDENT SUPPORT ACT

ED350167

HEARING

BEFORE THE

SUBCOMMITTEE ON SCIENCE

OF THE

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY U.S. HOUSE OF REPRESENTATIVES

ONE HUNDRED SECOND CONGRESS

SECOND SESSION

APRIL 29, 1992

[No. 121]

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THE AMERICAN MATH AND SCIENCE STUDENT SUPPORT ACT

WEDNESDAY, APRIL 29, 1992

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
SUBCOMMITTEE ON SCIENCE,
Washington, D. C.

The subcommittee met, pursuant to call, at 1:32 p.m., in Room 2318, Rayburn House Office Building, Hon. Rick Boucher [chairman of the subcommittee], presiding.

Mr. BOUCHER. The subcommittee will come to order.

This afternoon the Subcommittee on Science will consider the American Math and Science Student Support Act, H.R. 4595, which was introduced by our Michigan colleague Mr. Henry, who is serving in an ad hoc capacity this afternoon as a member of this subcommittee. He is a member of the full House Committee on Science, Space, and Technology. His legislation is designed to address the issue of attracting a greater proportion of U.S. citizens to graduate study in science, math and engineering.

The downward trend in the level of interest of American students in graduate study in science and engineering is well known. As an example of that trend, in 1988 a study by the National Research Council on personnel in engineering reported that 90 percent of engineering bachelor degrees, but only 45 percent of Ph.D.'s, are currently awarded to natural born citizens. The report further states that the proportion of Ph.D.'s has been declining, and I quote this language from the report, "even with selected efforts to restrict the number of foreigners admitted to graduate engineering education through the imposition of admission ceilings at a number of major universities."

In order to maintain the quality of graduate programs in the face of this shortfall in U.S. applicants, universities have increased enrollments of foreign students. Annual Ph.D. awards to foreign science and engineering students rose from approximately 2200 in 1980 to 6400 in 1989. The number of awards to foreign student in 1989 was some 30 percent of the total number of awards that were made.

Unfortunately, the availability of highly qualified foreign students interested in studying in the United States and remaining here after graduation has ensured an adequate supply of scientists and engineers holding advanced degrees. A study by the National Academy of Sciences in 1985 estimated that approximately one-half of foreign Ph.D. recipients in the natural sciences and engineering

who are in the United States on student visas remain in this country to enter the workforce. Most doctoral recipients who hold permanent visa status also remain.

Although foreign students have made an important contribution to the Nation's R&D enterprise, their growing numbers have masked the failure of our schools to stimulate the interest of U.S. students in science and to prepare those students to succeed in science and engineering courses at the college level. Beyond that there is no guarantee that U.S. universities will be able to attract indefinitely the brightest students from abroad or that those students will continue to remain in the United States in large numbers as the economies of their home countries prosper and continue to expand.

The purpose of H.R. 4595 is to encourage American institutions of higher education to use Federal R&D funds for support of more American students. Our witnesses today have been asked to comment on the possible effects of the bill on increasing the participation of U.S. citizens in graduate study in science, math and engineering. The subcommittee is also particularly interested in exploring with today's witnesses the possible administrative costs that would attend implementing this legislation, if it were passed, and in identifying any adverse effects of implementing the legislation on the universities' research activities and on the overall quality of their graduate programs. Finally, the witnesses have been asked to provide recommendations for additional measures that we might consider, or alternative measures that we might consider, which would be designed to increase the numbers of U.S. citizens and permanent residents who are applying for admission to our graduate programs in the math and engineering disciplines.

We welcome our witnesses today, and we very much look forward to their testimony on this important subject. And, before turning to our first witness, the Chair at this time will recognize the author of the bill that we are having the hearing on today, the gentleman from Michigan, Mr. Henry.

Mr. HENRY. Thank you, Mr. Chairman. And thank you for the opportunity to serve on a pro tem basis and return to my former subcommittee. I want to thank you as well as Chairman Brown for your efforts to put this hearing together in a very expeditious way. I want to express my appreciation for allowing me to sit on the panel and to participate in today's hearing.

I'm sure your offices, as has been mine, have been inundated, Mr. Chairman, with calls from university officials who are, to put it mildly, concerned about my legislation. As a former university professor, I can understand their concerns. Another layer of paperwork is the last thing researchers want to contend with when completing federally sponsored grant work, for such work already involves a number of reporting requirements.

But, as a public servant who must hold users of taxpayer dollars accountable, I believe my bill proposes a reasonable requirement for universities. It is not a racist or an anti-Asian bill, as some have simplistically suggested. Nor does it establish quotas on any university or for any group of students. Nor, on the other hand, is it as extreme as many America First advocates would prefer. It would not prohibit foreign graduate students from our campuses,

nor does it impose any quota or anything remotely like that whatsoever on any particular program. It would not lessen the quality of research at our universities. Rather what it requires is something very simple.

It says that all other things being equal American students should be given a preference by universities when they fill federally sponsored research positions. I want to stress "all things being equal." Undergraduate academic student support—Pell grants, Stafford loans, GSLs, PLUS loans—are, as a matter of law, available only, and I stress "only," to American students. Undergraduate student support—Pell grants, Stafford, GSL, PLUS loan, supplemental grants—they are by law limited only to students of American nationality.

At the same time that we are trying to increase those students to pursue majors in math, in the sciences, in engineering, and particularly to go on into graduate work in those fields a strange thing appears. The graduate programs funding research programs, many of which flow now not through the Department of Education, but through the National Science Foundation, Department of Energy, et cetera, have no such restriction. And, even more intriguingly, however, is that we find the money goes disproportionately to students who are not americans, and that seems to me to raise a very tricky issue as to which is coming first the chicken or the egg, as it were, in this cycle of inability to attract American students to major in the math and sciences and move forward at the graduate level in math and sciences, particularly in terms of the way in which this money is being dispersed.

Under this legislation, if no qualified American students are available to fill the research positions, it allows universities to fill them with foreign student by certifying that fact, very simply. Having said that, I want to acknowledge the complexity of the issue. There are a number of factors behind the dwindling number of American minority and non-minority graduate students being accepted into our Nation's universities, and I concede there is no simple solution to this dilemma. And I also concede that this issue in and of itself is not going to solve the problem. It only scratches the surface by asking universities to try to pull Americans into the math and sciences by certifying first of all that they could not find capable students to receive those funds.

Certainly foreign student shouldn't be made into scapegoats either for the shortcomings in our secondary and post-secondary educational system. But there is more to the fact that American—pardon me—that foreign graduate students are beginning to outnumber Americans in American universities than to say there simply isn't a sufficiently qualified pool of U.S. students for schools to choose from. Whether it is to diversify a student body or to gain more acclaim within the academic community, institutions have a number of reasons, academic and otherwise, for filling federally sponsored research positions with foreign student. Because foreign student are prevented from receiving other forms of Federal assistance, selecting them for research positions may allow a university or department to shift their student support burden, for example, and that is the other side to the issue I was just pointing out in

terms of Department of Education monies not being available to that same pool of students.

But money is a key barrier for many American students to overcome when contemplating graduate education. The primary Federal source of financial aid for graduate students comes in the form of research assistantships, 70 percent of all aid, and universities often prefer to fill these positions with foreign student. To the extent that this is done, it closes the door to American students who might have been encouraged to complete their degrees had such financial assistance been made available to them.

The problem is indeed particularly alarming in math and science. Fully 60 percent of engineering and 40 percent of the physical science graduate students in the United States are non-citizens. Some would contend that it is not just a coincidence that subsequently we find that 50 percent of all the junior engineering professors in the United States today are foreign non-nationals. However, couldn't there be a crucial, or casual—pardon me—connection as to why these professors are choosing foreign student as well over both minority and non-minority American students? And why is that a foreign student in these fields is more likely to be receiving Federal aid than an American student?

I pause here, Mr. Chairman, because I don't want to allow—I don't want to prohibit the time for interaction. That is why we are here. But I want to clarify again that the policy issues before us here are not to become discriminatory, but simply to suggest that if—and nor is it to prohibit foreign student from receiving direct Federal assistance, simply to suggest and to require that universities receiving these funds demonstrate that when the money goes to a foreign student it is because a qualified American student was not available to participate in that program.

Thank you, Mr. Chairman.

Mr. BOUCHER. Thank you, Mr. Henry.

The ranking Republican member of the subcommittee, the gentleman from California, Mr. Packard.

Mr. PACKARD. Thank you very much, Mr. Chairman. I want to join you in welcoming our witnesses. Particularly, I would like to give a special welcome to Dr. Stanford Penner, who is from my area. He is on the faculty at the UCSD—the University of California at San Diego. He is a professor of applied mechanics and engineering there, and he has participated in preparing the National Academy of Sciences report on foreign engineers in the United States, and I look forward to his testimony along with all the other witnesses.

The subcommittee holds this hearing today to review the bill that has been introduced by our colleague from Michigan, Mr. Henry, and I want to commend the gentleman from Michigan for his hard work. I must say that I generally agree with what I perceive to be the intent of his bill; namely, to increase the proportion of American students who are pursuing advanced degrees in engineering, science and math.

This is a problem that we have been grappling with for some time in this country, and this committee has discussed it before: How to excite the imagination of the American youth and spur them to pursue careers in science and engineering and math. I

know that the NSF is sponsoring many programs to enhance teacher training and improve the quality of science and engineering education at the elementary and secondary levels.

Mr. Chairman, again I anticipate a very interesting and exciting and lively discussion on this bill and look forward to the testimony of the witnesses.

[The prepared statement of Mr. Costello follows:]

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STATMENT OF U.S. REPRESENTATIVE JERRY F. COSTELLO (D-IL)
SCIENCE, SPACE, AND TECHNOLOGY SUBCOMMITTEE ON SCIENCE
"H.R. 4595, AMERICAN MATHEMATICS AND SCIENCE
STUDENT SUPPORT ACT"
APRIL 29, 1992

MR. CHAIRMAN, THANK YOU FOR CALLING THIS IMPORTANT HEARING. I AM PLEASED TO BE HERE TODAY AS WE DISCUSS H.R. 4595, THE AMERICAN MATHEMATICS AND SCIENCE STUDENT SUPPORT ACT, INTRODUCED BY OUR COLLEAGUE, MR. HENRY. I WOULD LIKE TO TAKE THIS OPPORTUNITY TO WELCOME OUR EXPERT PANEL OF WITNESSES. I BELIEVE IT IS IMPORTANT THAT WE HEAR THE VIEWS OF FEDERAL AGENCIES AND OF THE ACADEMIC AND INDUSTRIAL RESEARCH COMMUNITIES ON THIS BILL. I AM LOOKING FORWARD TO HEARING THEIR TESTIMONY, AS I AM CONFIDENT THAT THEY WILL PROVIDE WORTHWHILE AND INSIGHTFUL DISCUSSION ON H.R. 4595.

IT IS MY UNDERSTANDING THAT THIS BILL IS DESIGNED TO INCREASE THE PARTICIPATION OF U.S. STUDENTS IN GRADUATE SCIENCE, MATH, AND ENGINEERING PROGRAMS. THE BILL ENCOURAGES INSTITUTIONS OF HIGHER EDUCATION TO USE FEDERAL RESEARCH AND DEVELOPMENT FUNDING FOR THE SUPPORT OF OUR AMERICAN STUDENTS.

I AM INTERESTED IN LEARNING WHAT OUR WITNESSES BELIEVE TO BE

THIS STATIONERY PRINTED ON PAPER MADE OF RECYCLED FIBERS

THE POSSIBLE EFFECTS OF THE BILL ON INCREASING THE PARTICIPATION OF U.S. CITIZENS IN SCIENCE, MATH, AND ENGINEERING GRADUATE PROGRAMS, AS WELL AS ON THE FUTURE CAPABILITY OF UNIVERSITIES TO CONDUCT LEADING-EDGE RESEARCH, AND ON THE FUTURE SUPPLY OF SCIENTISTS AND ENGINEERS. I AM ALSO INTERESTED IN HEARING RECOMMENDATIONS ON ALTERNATIVE APPROACHES FOR INCREASING THE NUMBERS OF U.S. GRADUATE STUDENTS WHO ELECT TO PURSUE SCIENCE, MATH, AND ENGINEERING STUDIES.

I BELIEVE THAT WE MUST CONTINUE OUR COMMITMENT TO INCREASING EDUCATIONAL OPPORTUNITIES IN THE AREAS OF MATH, SCIENCE AND ENGINEERING. THE ECONOMIC, TECHNOLOGICAL, AND CULTURAL FUTURE OF OUR COUNTRY DEPENDS LARGELY ON OUR EDUCATIONAL RESOURCES AVAILABLE TO CITIZENS AND FUTURE CITIZENS OF OUR NATION. I HOPE THROUGH HEARINGS SUCH AS THIS WE WILL FURTHER OUR DEDICATION TO ENACTING POSITIVE REFORMS IN THIS AREA.

AGAIN, MR. CHAIRMAN, THANK YOU FOR CALLING THIS HEARING AND FOR YOUR CONTINUED LEADERSHIP OF THIS SUBCOMMITTEE.

Mr. BOUCHER. Thank you, Mr. Packard.

We welcome now our first witness for this afternoon who is Dr. John C. Hancock, the chairman of the Education and Human Resources Subcommittee of the National Science Board.

Dr. Hancock, we are pleased to have you with us. Without objection, your written statement will be made a part of the record, and we would welcome your oral summary and comments with respect to the legislation. Enlighten us, if you would, in particular with regard to whether there is a problem as perceived by the author of the legislation and suggested in these opening statements. If there is such a problem, is this the right way to approach it? Would this make any substantial difference? Enumerate, if you would, any pluses or minuses that you see with regard to this legislation. And, if there are other and better ways to address this concern, inform us of those as well. We will be pleased to hear from you.

Dr. HANCOCK. Thank you.

STATEMENT OF JOHN C. HANCOCK, PH.D., CHAIRMAN, EDUCATION AND HUMAN RESOURCES SUBCOMMITTEE, NATIONAL SCIENCE BOARD, WASHINGTON, D.C.

Dr. HANCOCK. Mr. Boucher and Mr.—

Mr. BOUCHER. And, Dr. Hancock, if you could use the microphone, and speak directly into it, that would help us hear you.

Dr. HANCOCK. Hello! All right?

Mr. BOUCHER. That's better. The switch I think needs to be thrown on the front. There is a switch on the bottom. Yes, that's it.

Dr. HANCOCK. Okay. Thank you.

Mr. Boucher, Mr. Henry, and Mr. Packard, it's a privilege for me to be here with you this afternoon. I have a very short formal statement which I would like to read, and then I would be more than pleased to engage in a dialogue with you concerning some of the very specific issues that Mr. Henry has raised.

Foreign-born recipients of doctoral degrees in the natural sciences and engineering have made important contributions to our economy during the past decade. Significant numbers of these graduates have remained in the U.S., as you have pointed out earlier, and now occupy key positions in industry and academia. Fifty-two point five percent of the 1990 doctoral class of science and engineers who are foreign born indicated that they had made definite plans to stay in the United States. This is up from 45.2 percent in 1980. Over 60 percent of the candidates in computer science, mathematics, physics, chemistry, chemical engineering, indicated that they had made similar plans.

Industry data also reflects this trend. The foreign-born in the science and engineering labor force increased from 10 to 17 percent during the 1972 to '82 time frame. Three years later, a 1985 survey of 300 U.S. firms reported that 20 percent of their S&E labor force were foreign born, and in certain high tech sectors this ranged as high as 40 percent.

In academia, foreign-born doctorates have played a very key role in meeting the needs for new faculty. A 1988 survey of departments in the natural sciences and engineering showed that the percentage of foreign-born faculty ranged from 19 to 26 percent. At

the assistant professor level, these numbers were high as 40 percent, thus reflecting the role of the foreign born in filling entry-level academic positions. But so much for the past. How about the future?

In view of the growing importance of science and engineering to our economy, and the intensifying competition we face from abroad, I feel we will need more, not fewer, S&E doctorates in the decade ahead. It is appropriate therefore to ask just where these graduates will come from.

According to the Bureau of Census, population of 22-year-old citizens, which started to decline in 1982—they stated that they will continue to decline until 1996. Now, as most students receiving the baccalaureate are approximately 22 years old, we would expect therefore a similar downturn in undergraduate science and engineering degrees, and we have indeed. Between 1985 and 1989, undergraduate degrees in these critical areas declined some 14 percent. As these students, these very students, form the primary pool for beginning graduates, it is apparent that unless we can effect a major turnaround in student interest, foreign student must continue to be an important component of our S&E graduate programs.

In summary, to do anything that would discourage foreign students from attending U.S. universities in the natural sciences and engineering at this time would do a disservice to industry and academia alike. We should not be discouraging steps—or taking steps to discourage these students, as I feel H.R. 4595 does. Rather we should focus on the real problem, and that problem is how best to attract more U.S. citizens to our graduate S&E programs. And I think that is the real challenge that we face as a Nation.

And once we accomplish this, once we are able to pull through more U.S. citizens into our graduate programs, I feel the foreign student issue will take care of itself.

This completes my formal comments, and I would be pleased to answer any questions which you or Mr. Henry would like to ask.

[The prepared statement of Dr. Hancock follows:]

Testimony of Dr. John Hancock, Member
National Science Board

Before the Subcommittee on Science
Committee on Science, Space and Technology
United States House of Representatives

April 29, 1992

Mr. Boucher, Mr. Packard, and members of the Subcommittee on Science, my name is Dr. John Hancock. I am a member of the National Science Board (NSB) and Chairman of the Board's Committee on Education and Human Resources. I appreciate the opportunity to speak to you today about international enrollments in U.S. universities.

International enrollments, particularly in graduate science and engineering (S&E) programs, have risen sharply over the last decade. The 1991 Science and Engineering Indicators reported that the number of international students in graduate S&E programs rose from 70,600 in 1983 to almost 102,500 in 1990, a 45 percent increase. In comparison, the number of U.S. citizens enrolled in S&E graduate fields rose from about 279,000 to almost 299,100 over the same period, only a 7 percent increase. Of those students enrolled in scientific and technical disciplines, international students are more likely to study engineering and physical sciences, whereas U.S. students tend more toward life and behavioral sciences. These trends are similar to those identified in a 1989 report of the NSB Committee on Foreign Involvement in U.S. Universities, which I chaired. I have attached a copy of this report to my testimony.

Our discussion of international participation in U.S. universities stems from broader concerns about America's competitiveness and the need to educate more American students in scientific and technical disciplines. As a former Executive Vice President for United Telecommunications, Inc., I share the interest of the Subcommittee in both competitiveness and science and engineering education. Clearly scientific and technical knowledge and skills are more important now than they have been in the past, given rapid changes in science, technology, and the global economy. In this environment, U.S. industries must choose between two general strategies. They can embrace the changes sweeping the world's economy; invest in science, technology, and education; and compete aggressively on the basis of excellence and innovation. Alternatively, they can attempt to postpone these changes; erect barriers to the outside world; and seek to preserve their status quo. The former option, while more difficult, lays the foundation for true competitiveness. The latter option is often futile and self-defeating.

Our universities face a similar situation. Science, technology, and education are becoming increasingly international activities. Furthermore, our Nation expects a great deal from its institutions of higher education. Universities are primary sources of new knowledge -- knowledge gained through teaching, research, study, and contacts with other institutions, both academic and otherwise. Universities are also expected to be centers for excellence, in education as well as research. To fulfill these twin missions, universities are expanding their relationships with industry, laboratories, and other academic institutions, both at home and abroad.

It may be tempting to try to erect barriers between our universities and the outside world, and thereby seek to keep to ourselves the knowledge and excellence that our universities create. Universities, for example, are under pressure, both direct and indirect, to restrict enrollments by foreign students in science and engineering fields. In many cases, this is driven by the mistaken belief that such restrictions will somehow boost U.S. enrollments. Such actions, however, would not accomplish their stated goals, and actually would do more harm than good to America's scientific, technological, and educational base.

Discouraging universities from accepting foreign students is a reaction to a symptom of a problem, not a solution to the problem itself. In disciplines with a high percentage of international graduate students, department chairs and faculty typically would like to see the proportion of international students decline somewhat, provided there were an abundant supply of well-qualified U.S. students. Unfortunately, U.S. students do not appear to be as ready or willing as their international peers to study science, mathematics, and engineering. The problem, therefore, is not that foreign students desire to study science or engineering at our universities. Rather, the real problem is that not enough of our own students -- particularly women, minorities, and disabled citizens, who are becoming an increasingly larger part of our work force -- share this desire.

Our real need, therefore, is to encourage more of our own citizens to pursue scientific and technical degrees. The National Science Foundation, for example, is supporting such efforts. NSF sponsors programs to improve teacher training and the quality of science and mathematics instruction at the elementary and secondary levels, in the expectation that through these efforts more of our students will become interested in science, and mathematics and will be better prepared to pursue such study later in life. NSF is also improving educational and research opportunities for undergraduate and graduate students, in order to encourage more of these students to complete their degrees and pursue scientific and technical careers.

Many of NSF's education and human resource programs are designed specifically to raise the participation rates of women, minorities, and disabled citizens in science, mathematics, and engineering. These programs include the Minority Graduate Fellowships; Career Access Opportunities in Science and Technology for Women, Minorities, and the Disabled; Research Careers for Minority Scholars; Minority Research Centers of Excellence; Research Improvement in Minority Institutions; and Alliances for Minority Participation (AMP). The goal of the AMP program, for example, is that by the turn of the century, the number of doctorate degrees in scientific and technical fields awarded annually to individuals from underrepresented minority groups should more than quintuple (to 2,000), and the number of B.S. degrees should nearly quadruple (to 50,000). These may not be instant results, but they are real results, results that will be measured by higher attainment and broader participation in the sciences by American students of all backgrounds.

Concern over international enrollments also tends to ignore the positive benefits that international students bring to our industries and universities. For example, approximately 50 percent of the international students who earn their doctorates in the United States stay in the United States and join the U.S. work force. Furthermore, the NSB's Committee on Foreign Involvement in U.S. Universities reported that 20 percent of the scientific and engineering work force employed by U.S. industry consists of foreign and naturalized U.S. citizens. This figure is even higher in key high technology sectors, such as aerospace, electronics, engineering, independent R&D laboratories, and others, where the proportion of foreign and naturalized U.S. citizens ranges from approximately 30 percent to 40 percent of the scientific and engineering work force. U.S. industries have advocated lowering rather than raising barriers to immigration in order to ensure the supply of skilled scientists and engineers.

The situation is similar in universities, where foreign-born scientists and engineers make valuable contributions to departments of science, mathematics, and engineering. The NSB Committee reported that approximately 10 percent of our Nation's full-time faculty members and doctorate holders in non-faculty academic positions are foreign citizens holding either temporary or permanent visas. Foreign participation is highest in computer science (approximately 18 percent) and engineering (approximately 14 percent), but is also significant in physics, biochemistry, physiology, mathematics, and economics (approximately 10 percent in each field).

Through these and other means, international students, scientists, and engineers continually provide new ideas, talents, and skills from which the U.S. benefits. This is true even of those foreign citizens who return home after having graduated from or worked in a U.S. university. Many international students

and faculty maintain close ties with the people they have met in the United States, and often mature into positions of leadership within their own countries. These contacts facilitate greater exchange of ideas, improve international collaboration in science, technology, and education, and lead to a better understanding of American and foreign cultures. These features, particularly greater sensitivity to the values and peoples of other nations, are important benefits for our citizens, who need to function more effectively in today's internationalized, interdependent world.

I would now like to turn to H.R. 4595, the "American Math and Science Student Support Act." For all the reasons stated above, I must express opposition to this bill. The title of this bill is itself a misnomer, because discouraging enrollments of international students would do nothing to encourage or support American students to study math or science. Furthermore, the time, effort, and resources spent on reporting on each and every international student in our universities would mean less time, effort, and resources available for improving educational opportunities for American students. We do not need additional distractions; we do need real solutions to real problems. We need to identify the challenges we truly face; design appropriate remedies; and commit the resources to make the changes we need.

Mr. Chairman, this concludes my testimony. Thank you again for the opportunity to testify, and I would be pleased to answer any questions you or your colleagues may have.

Report of the NSB Committee on Foreign Involvement in U.S. Universities

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I. EXECUTIVE SUMMARY

CONCLUSIONS AND RECOMMENDATIONS

Foreign-born assistant professors, postdoctorates, and graduate students now comprise a high fraction at U.S. universities in engineering, mathematics, physics, and computer science. In those disciplines they play a major role and are essential to the continuation of educational and research programs.

Recommendation 1: NSF should give high priority to its efforts to increase the pool of U.S. candidates for academic careers in engineering, mathematics, physics, and computer science.

Recommendation 2: NSF should give high priority to those programs which attract more U.S. students to careers in science and engineering.

Recommendation 3: Present NSF policy to leave to the discretion of principal investigators the selection of research assistants, including their nationality, has served science and the scientific community well. No change in the current policy is recommended.

Universities, and to some extent, industry would experience severe problems if the influx of foreign students would diminish abruptly and significantly. Present immigration policies and regulations encumber significantly efforts of American industry to employ foreign scientists and engineers as well as foreign-born U.S. graduate students.

Recommendation 4: NSF should encourage the U.S. Government to review its policy on visa conversion and immigration with the view of facilitating entrance of foreign scientists and engineers to the U.S. labor force.

Generally, foreign graduate students perform academically as well as U.S. graduate students. Difficulties have sometimes arisen in assignments, such as teaching assistantships, in which knowledge of the English language and/or the U.S. system of cultural values are important performance factors.

Recommendation 5: Universities should incorporate classes on American culture and values in their English language programs for foreign graduate students.

NSF sponsored University-Industry and Engineering Research Centers perform their research and educational programs in diverse programmatic and industrial settings. These circumstances call for flexibility at the local level.

Recommendation 6: The decision to accept foreign companies as industrial sponsors should continue to be left at the Center level. No general NSF policy is warranted. NSF should continue to monitor the foreign participation in the NSF supported ERCs and IUCs. Centers should be encouraged to ensure reciprocity of information transfer and access to sponsoring foreign laboratories by U.S. scientists and students before allowing foreign companies to become industrial sponsors.

Foreign involvement in U.S. universities shows an increasing tendency. Overall, these involvements have a positive impact.

Recommendation 7: NSF should monitor the inflows and retention of foreign students, postdoctorates, and faculty. In addition, NSF should explore the availability of information to monitor other foreign involvement in U.S. university programs, such as financial support for research, facilities' construction, and acquisition of expensive equipment. The conditions attached to such support should be noted.

MAJOR FINDINGS

Total Foreign Enrollment in U.S. Universities

- Over 1 million students study worldwide in foreign countries; 56 percent of these are enrolled in U.S. universities.
- Although the U.S. has the largest number of foreign students, it ranks only 14th in its proportion of foreign students to total student population.
- After a period of rapid growth—rising from 145,000 in 1974 to 337,000 in 1982—the rate of increase in the number of foreign students slowed considerably in the mid-eighties, reaching 356,000 by 1987. Earlier predictions of 1 million foreign students in U.S. academic institutions by 1990 are unlikely to be fulfilled.
- The growth in foreign enrollment has been accompanied by a shift in the regions from which these students come. In 1954, more than one-half of foreign students came from Europe, North America, and Latin America. By 1986, students from these regions made up only 27 percent of the total, while almost 50 percent came from South and East Asia. Students from the Middle East made up about 12 to 15 percent, both in 1954 and 1986 with an interim peak of 30 percent during 1979-80.
- The rise in foreign enrollment has occurred in the context of overall growth. The foreign proportion of total enrollment has remained relatively steady at between 2 percent and 3 percent during the last decade.

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Foreign Graduate Enrollment in Science and Engineering

- In 1987, foreigners comprised 45 percent of all graduate students in engineering, 43 percent in mathematics, and 41 percent in computer science of U.S. doctorate-granting institutions.
- The number of foreign students enrolled in graduate science and engineering (S&E) programs in U.S. doctorate-granting institutions has risen from 33,100 in 1977 to 76,200 in 1987, an average annual increase of 7.0 percent. During the same period, the number of U.S. citizens enrolled in these programs grew from 177,200 to 188,700—a 0.5 percent average annual increase.
- In general, foreign graduate students performed academically as well as U.S. students.
- In disciplines with a high percentage of foreign graduate students, chairpersons and faculty would like to see the proportion of foreign students somewhat lower if there were an abundant supply of well qualified U.S. students.
- Between 40 percent and 60 percent of foreign students graduating in the U.S. stay on to join the U.S. labor force.

Foreign-Born Faculty and Postdoctorates

- Foreigners comprised between 60 percent and 70 percent of the engineering postdoctorates (depending on subfield) employed since 1979. No consistent trend can be observed, possibly because of the small numbers involved—fewer than 1,000 each year. In the sciences, foreign postdoctorate employment increased from 41 percent to 41 percent between 1979 and 1987. This increase was particularly pronounced in the physical sciences, where 56 percent of the postdoctorates were held by foreigners in 1987.
- The number of foreign postdoctorates increased from 6,100 in 1979 to 10,800 in 1987, a 7 percent average annual growth rate. Over the same period, the number of U.S. postdoctorates rose from 12,000 to 14,500, an annual increase of 2 percent.
- In a 1986 sample of U.S. institutions with doctorate programs, 10 percent of the faculty members and doctorate-holders in non-faculty positions were foreign. Of these, 6.5 percent were foreign citizens on permanent visas and 3.5 percent were on temporary visas.
- Computer science departments had the highest proportion of foreign faculty and doctorate-holders in non-faculty positions in 1986 (18 percent), followed by engineering departments (an average of 14 percent).

Faculty with Foreign Baccalaureates

- In 1986, 16 percent of full-time faculty had received their baccalaureates at foreign institutions. This proportion was higher in certain subfields; for example, approximately one-quarter of the full-time faculty in mechanical and civil engineering as well as computer sciences had foreign bachelor's degrees.
- The proportion of faculty holding foreign bachelor's degrees is greater at the assistant professor level than at higher levels. The most dramatic illustration of this was in electrical engineering, where in 1986, 39 percent of the assistant professors held foreign baccalaureates, as compared to 20 percent at the associate professor level and 18 percent of full professors.

Foreign Participation in U.S. University Programs

- Research and development sponsored by foreign sources is only a small portion of all university R&D; it is also only a small part of all industry-sponsored university R&D.
- Foreign-financed R&D is concentrated in a few universities and is spread over several research fields.
- The top 5 universities receiving foreign funds account for 31 percent of all foreign investment in U.S. university research; the top 20 account for 70 percent. The top five universities are: Texas A&M University (primarily due to the Deep Sea Drilling Program), Harvard University, Massachusetts Institute of Technology, Oregon State University, and University of Wisconsin.
- Japan is the biggest sponsor of R&D at U.S. universities ($ 39.9 million), followed by the United Kingdom ($ 37.0 million) and West Germany ($ 35.6 million).
- U.S. university policies generally do not distinguish between U.S. and foreign sponsors.

Foreign Scientists and Engineers in Federal Laboratories

- In 50 Federal laboratories surveyed by the General Accounting Office in 1988, 5,700 foreign researchers—together with 57,000 U.S. researchers—worked at the laboratories as guest and visiting researchers or as participants in educational programs.
- Most of the foreign researchers conducted R&D either at the National Institutes of Health (34 percent) or Department of Energy research laboratories (32 percent).
- More than 80 percent of the foreign researchers were affiliated with foreign universities and other nonprofit organizations.

- The largest proportion of foreign researchers came from Japan (13 percent), followed by the United Kingdom and People's Republic of China (8 percent each).

Supply and Demand of Scientists and Engineers

- Between 1976 and 1986, the Nation's S&E work force has nearly doubled.
- Currently, there appears to be a rough balance between supply and demand for S&E personnel. This balance has been accomplished through substantial occupational mobility and increasing reliance on foreign-origin personnel. In light of demographic trends for the U.S. population, the reliance on foreign-origin personnel is likely to increase during the next decade.
- Between 1972 and 1985, foreign-born scientists and engineers increased from 10 percent to 17 percent of the S&E labor force. In the electronics industry, approximately 40 percent of the S&E labor force consisted of naturalized and foreign citizens in 1985.
- Present immigration policies and regulations encumber significantly efforts of American industry to employ foreign scientists and engineers as well as foreign-born graduate students.

II. FOREIGN STUDENTS IN U.S. UNIVERSITIES

WORLDWIDE STUDENT MOBILITY

Since the end of World War II, the United States has hosted the largest number of foreign students—340,000 in 1984, out of a worldwide total of more than 1 million. Although strictly comparable data are not available, it is useful to examine this influx in the context of other major host countries.

Around the world, foreign student enrollment has increased dramatically since 1970. (Table 1)

By 1984, this increase was 270 percent in the U.S., 278 percent in France, and 160 percent in West Germany. (A large increase was also reported for the U.S.S.R., although these data are only for the 1970–78 period.) The increase in the United Kingdom was significantly smaller—72 percent, this was due to the 1979 introduction of full cost tuition for foreign students.

Table 1. (Unesco)[a] Foreign Student Enrollment in Leading Host Countries, Selected Years, 1970–1984

Host Country	1970	1975	1980	1981	1982	1983	1984
United States[1]	144,708	179,350	311,882	326,299	336,985	338,894	342,113
France	34,500	93,750	110,763	129,047	134,566	130,244	126,310
Germany, F.R.	27,769	53,560	61,841	67,216	71,393	72,267	76,916
U.S.S.R.	27,918	43,287	62,942[2]	—	—	—	—
United Kingdom	24,606	49,032	56,003	50,684	46,000	42,267	—
Canada	22,263	22,700	28,443	32,303	35,556	35,365	—
Lebanon	22,184	—	31,028	26,343	29,460	—	—
Italy	14,357	18,921	29,447	30,652	29,221	28,068	27,548
Egypt	13,387	—	21,751	16,297	17,062	—	—
Saudi Arabia	1,404	4,028	14,296	16,469	17,275	16,529	—
Switzerland	9,469	10,113	14,716	15,515	15,657	16,277	16,830
Romania	1,786	4,971	15,688	16,962	16,251	14,808	13,068
India	7,804	8,880	14,710[3]	—	—	—	—
Austria	8,573	10,320	—	12,885	13,515	13,943	14,858
Sweden	—	—	13,182	—	—	—	—
Belgium	8,611	9,748	12,875	12,260	11,871	12,528	21,188
Spain	10,575	8,909	10,997	—	—	—	—
Brazil	—	—	12,800	11,680	10,829	—	—
Australia	7,525	8,356	8,777	10,921	12,104	10,797	12,028
Argentina	—	—	7,862[3]	—	—	10,049	—
Japan	4,447	5,541	6,543	7,182	8,117	9,523	10,092
Vatican City	8,128	5,740	9,104	7,417	8,239	9,211	9,656
German D.R.	—	5,386	7,106	7,411	7,987	8,472	9,143
Yugoslavia	—	2,358	4,426	5,022	5,610	6,664	7,962
Greece	5,796	1,049	7,673	—	—	—	—
Turkey	6,125	5,907	—	6,378	6,030	5,524	6,732

[a] Source: Unesco Statistical Yearbook 1986, Table 3.15, Education at the third level: number of foreign students enrolled, pp. 10-618, 621.
Source: Open Doors 1984-85.
[2] Figures are for 1978.
[3] Figures are for 1979.

HISTORICAL DATA AND TRENDS

Foreign Student Enrollment

Concurrent with the increase in foreign students in the U.S. was a similarly explosive growth in domestic enrollment. This resulted in only a modest increase in the proportion of foreign students to the overall student population; i.e., from 1.4 percent to 2.4 percent during the 1970–1984 period. Thus, in 1984, although the U.S. had the largest number of foreign students, it ranked only 14th in percentage of foreign students to total student population (Table 2). France (11.4 percent), the United Kingdom (4.4 percent), West Germany (4.9 percent) and Switzerland (17.4 percent)—among other Western countries—all had larger percentages. Near the other end of the spectrum was Japan, with less than 0.5 percent of students from other countries.

The rate of increase in the number of foreign students coming to the U.S. slowed considerably in the mid-eighties. Earlier predictions of 1 million foreign students in U.S. academic institutions by 1990 seem increasingly unlikely to be fulfilled.

Table 2. (Unesco)* Foreign Student and Total Enrollment in Leading Host Countries, 1983

Host Country	Foreign Enrollment	Total Enrollment	% of Total Enrollment
United States[1]	338,894	12,393,700	2.7
France	130,244	1,144,080	11.4
Germany, F.R.	72,267	1,471,964	4.9
U.S.S.R.[2]	62,942	5,301,300	1.2
United Kingdom	42,267	897,000	4.7
Canada	35,365	1,192,925	3.0
Lebanon[3]	29,408	73,052	40.3
Italy	28,068	1,120,342	2.5
Egypt[3]	17,062	873,565	2.0
Saudi Arabia	16,529	87,821	18.8
Switzerland	16,277	95,661	17.0
Romania	14,808	174,042	8.5
India[3]	14,710	5,345,580	0.3
Austria	13,943	154,126	9.0
Sweden[4]	13,182	223,295	5.9
Belgium	12,528	245,762	5.1
Spain	10,997	787,864	1.4
Brazil[3]	10,829	1,479,397	0.7
Australia	10,792	349,243	3.1
Japan	9,523	2,409,983	0.4
Vatican City	9,211	9,211	100.0
German. D.R.	8,472	434,326	2.0
Argentina[4]	7,882	580,626	1.4
Yugoslavia	6,694	375,393	1.8
Greece[1]	6,623	124,694	5.3
Turkey	5,524	335,090	1.6

*Source: Unesco Statistical Yearbook 1986, Table 3.15, Education at the third level—number of foreign students enrolled, pp. III 418–421.
[1] Source: Open Doors, 1983-84.
[2] Figure is for 1978.
[3] Figure is for 1982.
[4] Figure is for 1979.

Preferences for Countries of Destination

Preferences for countries of destination vary in different world regions and countries. In 1984, almost 60 percent of students who relocated from South and East Asia came to the United States whereas 40 percent of African students went to France and just 18 percent came to the U.S. (Table 4).

By country, the U.S. was selected by 87 percent Canadian, 79 percent Japanese, 78 percent Korean, 67 percent Nigerian, and 51 percent Chinese outbound students. Other trends can be observed in students from Algeria and Morocco (79 and 78 percent went to France) and Turkey (65 percent went to the Federal Republic of Germany).

These patterns of student mobility suggest that linguistic competency, geographic proximity, and cultural or ideological affinity strongly influence the choice of target country.

The shifts in the representation of various countries may be traced to a combination of factors. First, at the end of World War II, many European universities were in need of rebuilding, as these institutions were restored to their positions, the proportion of students from these countries seeking education abroad declined.

Second, economic factors play a significant role; the growth in the number of students from OPEC nations—which reached 35 percent of the total in 1979—reflects the increasing purchasing power of these countries during the oil shortage of the early seventies.

Finally, political changes have resulted in dramatic changes in the number of students coming to the U.S. from certain countries. The overthrow of the Imperial Government in Iran led to a sharp decline in the number of Iranian students enrolled in U.S. institutions; these dropped from 51,000 in 1979 to 12,000 in 1986. Conversely, the opening up of relations with the People's Republic of China has resulted in an increasing number of Mainland Chinese students in the United States; these have risen from less than 1,000 in 1974 to 20,000 in 1986.

Graduate Enrollment

Since 1975, foreign student enrollment in graduate S/E programs has grown more rapidly than has U.S. enrollment during the same period. The enrollment of foreign students increased by over 125 percent between 1974 and 1986; in contrast, graduate enrollment of U.S. students increased by just under 15 percent. Because foreign students' enrollment growth has exceeded that of U.S. students, their proportion as a share of all graduate S/E students has increased, rising from 16 percent in 1975 to 28 percent in 1986 (CHART 1).

Enrollments for both foreign students and U.S. students have increased considerably within certain fields. For example, graduate enrollment in computer science nearly tripled for U.S. students between 1975 and 1986; during

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Table 3. (Unesco)* Distribution of Foreign Students by World Region of Origin in Leading Host Countries†

Region of Origin	Host Country‡							
	U.S.	France	Germany, F.R.	U.S.S.R.	U.K.	5 Leading Countries	Next 45§ Countries	Total 50 Countries
Africa	18.4	40.5	2.4	7.2	5.6	74.1	25.9	183,109
Europe	17.7	13.7	18.7	10.8	2.1	55.1	44.9	159,931
Middle East	30.9	7.6	12.9	—	4.3	56.6	43.4	156,450
North America	46.3	15.2	6.8	—	5.6	81.1	18.9	73,016
Oceania	48.4	2.0	2.4	—	4.1	65.9	34.1	7,310
Latin America	63.1	8.0	7.0	11.3	2.4	75.1	24.9	33,855
South and East Asia	58.9	0.4	4.5	12.0	7.5	79.8	20.2	208,353
U.S.S.R.	17.1	0.0	7.5	—	0.8	25.7	74.3	1,146
% of World Total	36.9	14.2	7.8	6.9	4.6	70.4	29.6	918,350

*Source: Unesco Statistical Yearbook 1986, Table 3.10, Education at the third level, number of foreign students enrolled, pp. III 425–449.
†Percentages are based on student numbers for each region of origin.
‡Figures for the United States are from 1984, for France, the Federal Republic of Germany and the United Kingdom from, for U.S.S.R. from 1978.
§Figures are for 1984 for most countries.

the same period, foreign student enrollment in this field increased five-fold. Foreign student enrollments also increased noticeably in the mathematical sciences; between 1977 and 1987, the foreign student share of enrollment increased from just under 25 percent to 40 percent of total graduate enrollment. In contrast, however, foreign students in 1987 made up less than 5 percent of the total in psychology and only 12 percent in the health sciences.

Overall, foreign students were more likely to be enrolled in engineering graduate programs than in science studies, despite enrollment growth in both science and engineering; these preferences remained apparent. Between 1975 and 1987, foreign students increased their representation among all engineering graduate students from 32 percent to 45 percent; among science students, they increased their representation from 12 percent to 24 percent. (Charts 1 and 2)

The proportion of foreign citizens among doctorate recipients remains higher in engineering than in the sciences. Across broad science fields, proportions are highest in computer sciences, lowest in biological sciences and psychology.

Post graduation plans of foreign doctorate recipients vary considerably by field. Overall, nearly 80 percent of the holders of permanent visas and over 50 percent of the holders of temporary visas planned to stay in the U.S. Foreign physical science Ph.D.'s were more likely to cite postdoctoral study as their reason for staying, regardless of visa status. Engineering doctorate holders with permanent visas indicated more often industrial employment as their reason for staying, those on temporary visas, postdoctoral studies and academic employment.

EDUCATIONAL COST

The costs of higher education in the U.S. are rising rapidly and therefore estimates for educational costs also change rapidly, thus introducing considerable uncertainty into the numerical values obtained. To estimate the subsidies to resident foreign S/E students from U.S. sources, data were obtained by the NSF Division of Policy Research and Analysis (PRA) from published sources, consultations with university planners, and in-house statistical analyses.

Costs of training science and engineering students were estimated to be on the order of $6,000 to $7,500 for undergraduate students and $16,000 to $19,000 for graduate students during the 1985–1986 academic year.

In the absence of financial assistance, expenses for an individual for an academic year are the sum of tuition and fees and living expenses; these vary depending on whether the university or college is public or private. For the 1985/86 academic year, tuition and fees for an out-of-state resident at a public institution were estimated at $3,500 and $8,400 at a private institution. Typical living expenses for the academic year were estimated at $6,300.

Based on data from the International Institute for Education and the National Academy of Sciences, it was estimated that U.S. sources covered—on average—about 10 percent of the living and tuition expenses over the population of foreign S/E undergraduates and about 25 of the living and tuition expenses over the population of graduate students.

In the 1985/86 academic year, about 135,000 nonresident foreigners were enrolled in S/E training at U.S. colleges and universities. About 60 percent of these were enrolled in undergraduate training, about 75 percent attended public universities and colleges, and over 90 percent were enrolled full time.

Thus, of the approximately $2.4 billion total spent in training nonresident foreign students during the 1985/86 academic year, $1.1 billion were covered by U.S. sources and $1.4 billion were paid for by the individuals or foreign institutions. Sixty percent of the expenditures by U.S. sources represented the excess of training costs over tuition charges at public universities and colleges. In

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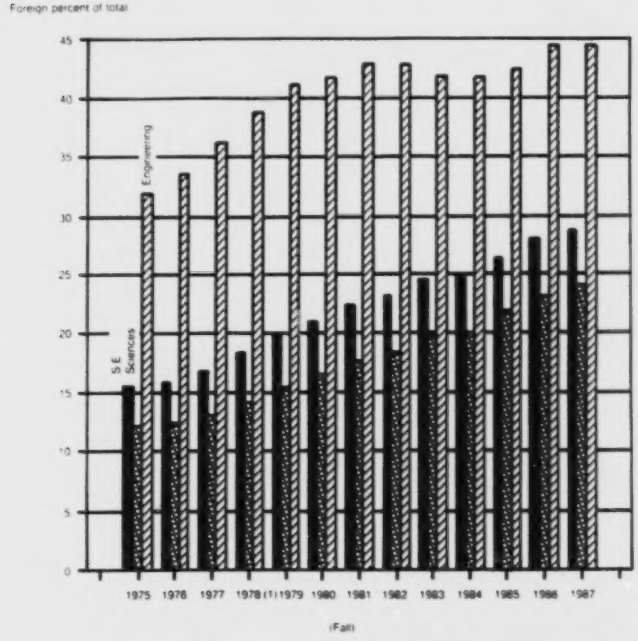
Chart 1. Foreign Percent of Total Graduate Science/Engineering Enrollment in Doctorate-Granting Institutions



Source: National Science Foundation, SRS

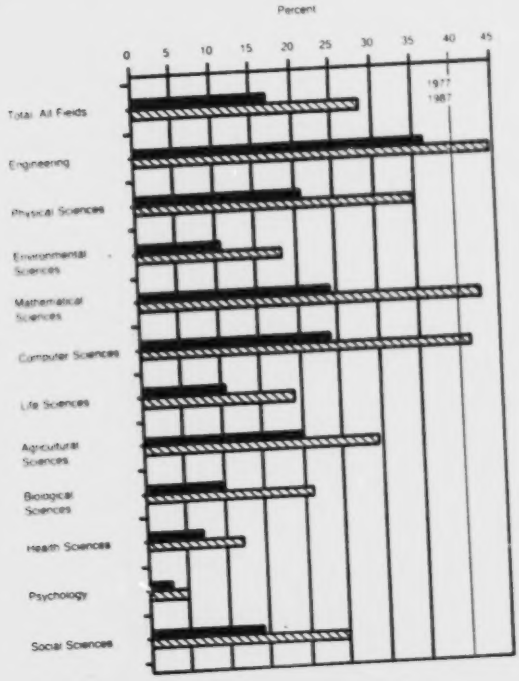
other words, most of the subsidies to foreigners represented transfer payments from State Governments. In turn, 80 percent of these funds went to graduate students. Overall, out of the $1.1 billion training cost of nonresident foreign students which is covered by U.S. sources, about $468 million went to the training of foreign graduate students or about $42,500 per student for a two-year master's program.

Using a similar procedure, the cost of precollege education (i.e., from kindergarten to high school) in the U.S. can be estimated. Assuming that a person attends elementary school and high school for 13 years, the cost of precollege education equals the sum of average per pupil total expenditures during the 13-year schooling period. If a person received a Ph.D. in June 1984, the cost of precollege education in 1988 dollars is $32,000. Education to the baccalaureate adds $28,000 and to the master's level another $35,000; this assumes a four-year undergraduate period and a two-year period for the master's program. Thus, if a foreign student enters a U.S. university with a bachelor's degree from his home institution, such an education would have cost $60,000 in the United States.

QUALITY IMPACTS

That foreign graduate students approach numerical parity with U.S. students in several disciplines has in-

Chart 2. Foreign Full-Time Graduate Science/Engineering Enrollment in Doctorate-Granting Institutions by Field



Source: National Science Foundation, SRS

creasingly attracted attention in the last decade. A recent study by E. G. Barber and R. P. Morgan provided data and analyses of this phenomenon at U.S. engineering schools through a survey of departmental chairpersons and faculty in engineering programs (IIE Research Report Series Number 14, "Boon or Bane: Foreign Graduate Students in U.S. Engineering Programs, 1988"). The authors conclude that "... high proportions of foreign graduate students are, at the present time, essential to the operation of U.S. engineering programs, but they also render these programs vulnerable." Both industry and engineering schools would experience severe problems if engineering schools should severely restrict the training of foreign students or if the influx of foreign students would diminish abruptly and significantly. Industry is affected because a significant proportion of foreign graduate students ultimately obtain employment in the United States. At universities, the supply of U.S.-born students alone would be insufficient to keep engineering educational as well as research programs at their present level.

According to the study, foreign graduate students are generally considered academically as qualified as U.S. students, although they are perceived as showing some sig-

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nificant differences. On the positive side, they are generally thought of being more diligent in their work and having a higher level of theoretical sophistication. However, because of difficulties in communication, they are perceived as being less effective in some respects, especially in positions as teaching assistants. Other problems sometimes mentioned which relate to their performance include their lack of familiarity with U.S. undergraduate culture and academic norms (E. G. Barber and R. P. Morgan: "The Impact of Foreign Students on Engineering Education in the United States," *Science*, Vol. 236, 1987"). With respect to the U.S. system of cultural values, B. M. Vetter observed recently that "Most of these foreign teachers are men who come from cultures that do not view women as colleagues. The result can be what American women see as sexual harassment and as refusal to take them seriously as students." (B. M. Vetter "Demographics of the Engineering Pipeline," *Engineering Education*, May 1988, "49–"40). In a recent study on teaching assistants, R. M. Diamond and P. Gray recommended "That in addition to the general program for all new teaching assistants, special orientation programs be established for international teaching assistants and that these programs include:

- information about the organization and administration of American universities,
- information on the cultural differences they can anticipate,
- a clarification of the role of student and teacher in American universities."

(R. M. Diamond and P. Gray: "National Study of Teaching Assistants," Center for Instructional Development, Syracuse University, January 1987").

Overall, if there were an abundant supply of well qualified U.S. graduate students, both chairpersons and faculty would like to see the proportion of foreign students somewhat lower.

To ascertain the validity of the findings in other fields of science, a recent survey questioned a sample of Ph.D.-granting graduate departments in four fields of science (chemistry, physics, mathematics, and computer science) concerning the impact of foreign students on their programs. The survey revealed substantial dependence upon the supply of foreign applicants in order to maintain the quality of graduate programs. Prevailing responses in all four fields indicated a shortage in the supply of high quality U.S. applicants, accompanied by a surplus of high quality applicants from abroad. The survey indicated very strong competition for the limited pool of high quality U.S. students. Although few departments have a formal policy limiting the percentage of foreign applicants admitted to their programs, many suggested that in the absence of constraints on funding, legislative limitations, or informal efforts to maintain a balanced enrollment, the proportion of foreign students would be higher than it is, even to the degree of being able to fill their program's entire enrollment with high quality foreign students. There was consensus that this situation was unlikely to change greatly in the near future.

The impact of the foreign enrollment on the quality of programs was generally viewed as positive. The preparation and diligence of foreign students was generally seen as better than that of U.S. students upon entry to graduate school, although most respondents seemed to believe that the differences evened out over the course of the education of those attaining a Ph.D. degree. While foreign students often lacked experience in research prior to entering graduate school, many respondents noted a need to improve U.S. undergraduate programs in this respect as well. Nearly all programs have measures in place to ensure that the English language skills of foreign students do not have a detrimental effect on the quality of educational programs. In addition to the professional competence of foreign students, many noted that the cultural diversity represented an additional enhancement of their programs.

NSF SUPPORT FOR FOREIGN STUDENTS

In the above-mentioned survey of graduate departments in chemistry, physics, mathematics, and computer science, respondents were asked to rank the sources of funding for entering students (usually teaching assistants) and for research assistants. NSF funding was generally ranked as less important for entering students, with in-house university funds being the primary source of teaching assistantships. Where NSF funding was mentioned as a source for entering students, it usually ranked second or third for U.S. students, and was less likely to figure in the support of foreign students.

NSF support was usually ranked as the primary or secondary source of funding for research assistants, usually in tandem with "Other U.S. Government Funds." For most departments, the rankings for U.S. and foreign students were the same. This suggests that little distinction has been made in the evaluation of U.S. and foreign students for support involving U.S. government funds, whether from NSF or other agencies, which was consistent with responses indicating that there was little difference in the assignments given to U.S. and foreign research assistants unless a department had a particular involvement with a laboratory doing defense related research.

III. FOREIGN-BORN FACULTY IN U.S. UNIVERSITIES

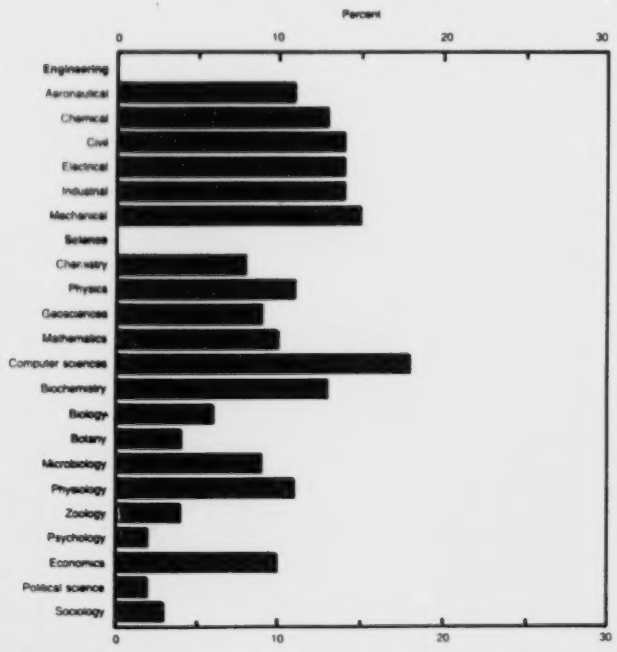
HISTORICAL DATA AND TRENDS

In 1986, NSF surveyed department heads in 21 selected science and engineering fields. Two of the questions contained on the survey targeted foreign faculty members. The first dealt with citizenship status, and asked for the numbers of non-resident alien faculty members who were on temporary or permanent visas. The second asked for the number and academic rank of foreign faculty members who did not receive their baccalaureate in the U.S.

The survey population was 2,074 doctorate-granting departments in the 156 institutions that had S/E doctoral programs in the fall of 1984 and which received at least $2.15 million in Federal R&D funding in FY 1983. Responses were received from 1,664 (80 percent) of the departments located in 154 institutions. Responses to the relevant questions are summarized below.

Chart 3. Foreign Participation in Academic Departments: 1986

(Full-time faculty and doctorates in non-faculty positions)



Source: National Science Foundation, SRS

Distribution in Institutions/Departments

In 1986, 10 percent of the 40,393 full-time faculty members and doctorate-holders in non-faculty positions at the universities surveyed were foreign. Of these, 6 percent (2,5"5) were foreign citizens on permanent visas and 4 percent (1,310) were on temporary visas. Computer science departments had the highest proportion of foreign faculty at 18 percent, followed by an average of 14 percent for engineering (CHARTS 3 and 4).

In all, over one-half of the departments surveyed employed foreign faculty members and foreign doctorate-holders in nonfaculty positions. Of these, 51.0 percent employed between one and five foreigners, and 7.9 percent employed five or more. Approximately 35 percent of the departments surveyed had no foreign faculty members.

By department, the average number of foreign faculty members was 2.3. The highest average numbers of foreign faculty members were in electrical engineering and mathematics departments; these averaged 4.6 and 4.0, respectively. The average for faculty on permanent visas was 1.5, less than 1.0 person per department was on a temporary visa. Foreign faculty in the life sciences, physical sciences, and engineering tended to be on temporary visas more often than were faculty members in the social sciences, mathematics, psychology, computer science, and environmental science.

Faculty with Foreign Baccalaureates

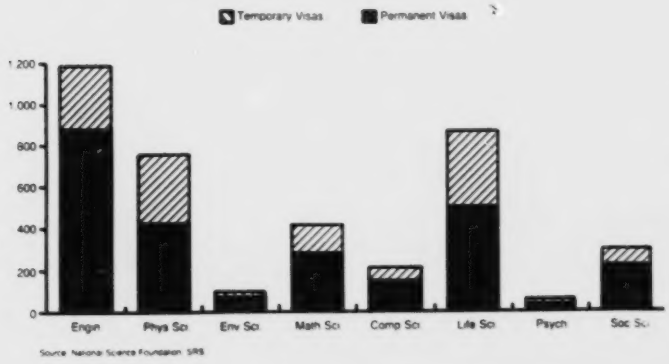
In 1986, sixteen percent of full-time faculty had received their baccalaureates at foreign institutions. This proportion was higher for faculty in engineering fields. For example, one-quarter of the full-time faculty in mechanical and civil engineering and one-fifth of those in chemical engineering had foreign bachelor's degrees. Figures for foreign involvement in U.S. faculties would be significantly higher if foreign born faculty with U.S. baccalaureates were included (Charles E. Falk, "Foreign Engineers and Engineering Students in the United States" in *Foreign and Foreign-born Engineers in the United States*, National Academy Press, 1989).

In addition, 46 departments reported that 50 percent or more of their faculty had foreign bachelor's degrees. Fifty-two percent of these were science departments, 44 percent engineering departments, and 4 percent a combination of science and engineering. The number of total faculty in these departments ranged from 3 to "5 with an average of 18.

In the departments surveyed, there were—on average—4.0 full-time faculty members with baccalaureates from foreign institutions. Reflecting the greater proportion of engineering faculty with foreign bachelor's degrees, these averages were 5.9 and 3.5 for engineering and science departments, respectively.

Responses to the ranking question revealed that the proportion of faculty members with foreign baccalaureates generally was greater at the assistant professor level than at higher levels (e.g., associate professor and full professor levels). This was not the case, however, within the geosciences, physiology, and zoology. In these fields, the proportion of full professors holding foreign baccalaureates exceeded those at the assistant and associate professor levels (Table 4).

Chart 4. Foreign Faculty by Visas Type: 1988



Source: National Science Foundation, SRS

Table 4. Faculty with Foreign Baccalaureates by Department and Rank, 1986

Department	Total		Professor		Assoc. Professor		Asst. Professor	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Engineering								
Aeronautical	114	22	52	18	29	27	33	30
Chemical	242	20	96	14	67	27	79	30
Civil	501	26	227	23	130	24	144	35
Electrical	683	23	287	18	145	20	253	39
Industrial	106	21	31	13	25	19	50	33
Mechanical	560	25	237	20	130	24	193	38
Sciences								
Chemistry	432	12	285	13	56	8	91	16
Physics	770	20	531	20	117	17	122	26
Geoscience	197	16	125	19	44	14	28	10
Computer Science	335	26	93	20	64	19	178	36
Mathematics	881	19	457	18	211	17	213	24
Biochemistry	319	16	161	15	82	15	76	17
Biology	356	12	219	14	70	8	67	11
Botany	52	8	29	8	12	6	11	8
Microbiology	210	13	107	14	55	11	48	13
Physiology	251	15	123	16	70	13	58	14
Zoology	45	5	25	6	14	5	6	4
Psychology	104	3	61	3	18	2	25	4
Economics	371	15	158	13	76	13	137	19
Political Science	128	7	75	8	26	5	27	7
Sociology	93	5	45	5	24	4	24	7

Source: Faculty Survey, National Science Foundation, SRS

IV. FOREIGN PARTICIPATION IN U.S. UNIVERSITY PROGRAMS

NSF-SPONSORED CENTERS

Foundation guidelines to NSF-sponsored University Industry and Engineering Research Centers place the decision to include foreign firms with individual Centers. In the case of University-Industry Centers, for example, Center Directors have the authority to decide on foreign participation; in practice, they consult usually informally with their industrial members prior to the decision. In addition, NSF encourages Centers to be alert to opportunities for participation by foreign firms that are likely to result in knowledge gains and to assure reciprocity in information exchange between U.S. and foreign participating firms. In all cases, foreign firms must adhere to guidelines for U.S. firms and provide information as well as financial support to Centers.

Centers, in general, distinguish between the U.S. and foreign firm participation primarily on the basis of competitiveness concerns, and on the likelihood that U.S. companies may discontinue participation if foreign companies join. Major foreign companies have sometimes been excluded from participation on this basis. These trends may be changing. Increasingly, foreign firms are encouraging U.S. access to their laboratories through offering long term visits to U.S. scientists and seminars on foreign firm research activities. Centers are becoming more interested in seeking out pockets of excellence abroad, access to foreign laboratories, and knowledge contributions by foreign firms to Center activities. The participation of foreign students in Center activities follows, in general, the same patterns as their participation in university departments. Table 5 and Chart 5 illustrate the degree of foreign student involvement.

OTHER PARTICIPATION

A recent General Accounting Office study (GAO, "Foreign Sponsorship of U.S. University Research," 1988) was aimed at providing information on foreign firms' and governments' sponsorship of R&D at U.S. universities. Study results—which were obtained through a survey mailed to the 150 universities with the largest R&D expenditures in FY 1985—showed that foreign funds (as distinct from funding received from international sources such as the World Bank) accounted for $74.5 million, or about 1 percent of the $6.8 billion in total FY 1986 R&D expenditures by the 107 universities reporting foreign funds.

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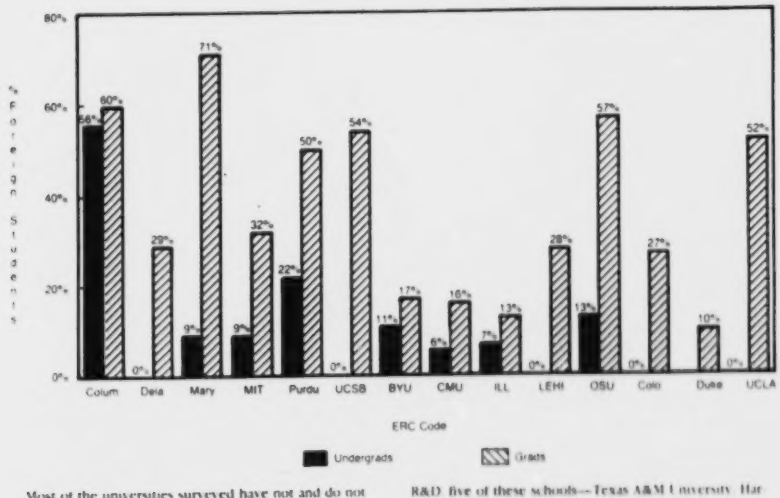
Table 5. Foreign Student Participation in IUCs: Data from 35 IUCs by Region

University	IUC	Total Undergr	Foreign Undergr	Percent Foreign	Total Grad	Foreign Grad	Percent Foreign
Northwest							
Colorado Sch of Mines	ASPPRC	2	0	0%	14	1	7%
Washington, Univ of	PACC	1	0	0%	20	2	10%
Wyoming, Univ of	CMM	2	0	0%	22	11	50%
Subtotal		5	0	0%	56	14	25%
Southwest							
Arizona, Univ of	OCC	0	0	0%	85	22	26%
Arizona, Univ of	CMC	1	0	0%	10	5	50%
Calif, Univ of at Berkeley	CSA	4	1	25%	23	4	17%
New Mexico Tech	RCEM	4	0	0%	3	1	33%
Oklahoma State Univ	WHRC	4	0	0%	20	11	55%
Southern Calif, Univ of	CMA	0	0	0%	8	8	100%
Texas A&M Univ	CESHR	0	0	0%	14	0	0%
Texas, Univ of at Arlington	CAEDS	14	2	14%	17	13	76%
Texas, Univ of at San Antonio	UICRC	4	1	25%	9	2	22%
Subtotal		31	4	13%	189	66	35%
Midwest							
Case Western Reserve Univ	CAPR	8	4	50%	9	7	78%
Illinois Inst of Technology	CIITS	0	0	0%	10	7	70%
Iowa State Univ	CNDE	3	0	0%	14	6	43%
Iowa, Univ of	CSDO	7	0	0%	37	32	86%
Northwestern Univ	CET	0	0	0%	14	5	36%
Ohio State Univ	CWR	0	0	0%	22	16	73%
Subtotal		18	4	22%	106	73	69%
Northeast							
Alfred Univ	OGR	4	0	0%	12	9	75%
Carnegie-Mellon Univ	CISR	3	0	0%	8	4	50%
Lehigh Univ	PMC	3	1	33%	15	10	67%
Lehigh Univ	CIMS	0	0	0%	9	0	0%
Massachusetts, Univ of	IRP	4	0	0%	26	16	62%
MIT	CPPP	4	1	25%	6	2	33%
Northeastern Univ	CER	7	0	0%	19	14	74%
Rensselear Poly Inst	CICG	10	2	20%	25	9	36%
New Jersey Inst of Technology	HTWMC	5	1	20%	57	23	40%
Rutgers Univ	ROC	100	0	0%	35	13	37%
Rutgers Univ	CPR	8	2	25%	14	7	50%
Subtotal		148	7	5%	226	107	47%
Southeast							
Florida Univ-Purdue Univ	CSE	0	0	0%	6	2	33%
Georgia Inst of Technology	MHRC	4	0	0%	36	10	28%
North Carolina State Univ	CCSP	1	0	0%	35	12	34%
North Carolina State Univ	CAPPS	2	0	0%	2	1	50%
North Carolina, Univ-Duke	LTC	1	0	0%	9	0	0%
Tennessee, Univ of	MCEC	6	0	0%	19	8	42%
Subtotal		14	0	0%	107	33	31%
Grand total		216	15	7%	684	293	43%

Source: National Science Foundation, ECD

Overall, foreign businesses supported very little U.S. university research. Universities reported that $2.6 million (.5 percent) of their foreign funds were from business sources; $46.8 million (6.4 percent) came from non-business sources, including governments and nonprofit organizations. Foreign businesses thus accounted for about one third of 1 percent of the R&D expenditures of the 10 universities. By contrast, U.S. businesses accounted for $512.5 million, or 8 percent of these universities' total R&D expenditures.

Chart 5. Foreign Student Participation in ERCs



Most of the universities surveyed have not and do not plan to establish foreign offices, although one university reported having a permanent office in a foreign country to solicit funding, and two others planned to establish such offices in the next two years. Only five universities had a foreign business or other organization under contract to solicit funding and/or negotiate licenses for university developed technologies; six more plan to do this within the next two years.

Top University Recipients of Foreign Funds

Foreign funds are highly concentrated in a few universities. While 107 of the universities responding to the GAO survey reported receipt of some foreign funds for R&D, five of these schools—Texas A&M University, Harvard University, Massachusetts Institute of Technology (MIT), Oregon State University, and the University of Wisconsin—accounted for 51 percent of these funds (Table 6). Conversely, 74 of the universities each received less than $500,000 in FY 1986 from all foreign sources. For all five of the top foreign-funded universities, such funding made up only a small portion (between 1 percent and 9 percent) of their total R&D expenditures.

Except for the research sponsored at MIT, most of the foreign-funded R&D at the top five universities is not in "emerging technologies"—i.e., technologies which will lead to new products or processes and which are ex-

Table 6. Universities' R&D expenditures from foreign and all sources: FY 1986 (dollars in millions)

Recipients	Total from foreign sources	Percentage of foreign sources	Total from all sources	Percentage of all sources
All universities*	$74.3	100	$6,808.2	100
Top 20*	58.4	79	2,190.0	32
Top 5*	37.7	51	918.2	13

*Of the 107 universities reporting foreign funds. Ranking of universities is in terms of reported R&D expenditures from foreign sources.

SOURCE: GAO, "Foreign Sponsorship of U.S. University Research," 1988.

pected to play a significant role in the economic growth of the U.S. by the year 2000. Aside from this point, however, there was very little similarity among the five universities in terms of either their sponsoring countries or research fields. The following delineates the source and use of foreign funding for R&D at the top five universities.

Texas A&M University. Texas A&M received $15.2 million in foreign funding; this represented 9 percent of its total R&D funding. Almost all (99 percent) of the foreign funding was from non-business sources, and was provided in support of the ongoing international ocean-drilling program, sponsored by NSF. Canada, France, Japan, the United Kingdom, West Germany, and the European Science Foundation each contributed about $2.5 million to the program in 1986.

Harvard University. Of Harvard's total R&D expenditures, $10.8 million (six percent) were provided by foreign funding. Non-business sources accounted for 95 percent of these funds, while four countries—Korea, Indonesia, Bangladesh, and Kenya—provided 90 percent of the funding. Almost all of the research (92 percent) was focused on trade, finance, and banking, through the Harvard Institute for International Development, the funding supported development of a trade ministry, strengthening the analytic capability of the ministry of finance, and reviewing the capital incentive structure.

Massachusetts Institute of Technology. MIT's foreign R&D expenditures totaled $5.3 million, representing 2 percent of its total R&D funding. Businesses provided almost all (98 percent) of the funding. Japan accounted for 42 percent of the funds, the United Kingdom for 15 percent, and other West European countries for an additional 28 percent. About three-quarters of foreign-funded research was distributed among eight engineering fields.

Oregon State University. Of Oregon State University's total R&D expenditures, $4.1 million (five percent) were received from foreign sources. Just under 80 percent of this funding was provided by non-business sources. Half was from Mexico, Poland, the U.S.S.R., the United Nations, and Tunisia. Other Middle East countries and multinational businesses accounted for another 45 percent of these funds. Almost all (97 percent) of the foreign funds were designated for developing agricultural colleges, increasing capacity for agricultural extension, and agricultural management capacity.

University of Wisconsin. At the University of Wisconsin, $2.4 million in foreign funds were received; this represented 1 percent of the university's total R&D expenditures. Almost 90 percent was from business sources, over 10 countries provided the funding. Approximately one-half of the funds was for research in weather monitoring, and 10 percent for agriculture; the remainder was dispersed over more than eight research fields.

Sources of Foreign Funds

According to the GAO sample, numerous countries support R&D in U.S. universities. Although Japan sponsored more R&D than did any other country in FY 1986, no single country predominated in providing R&D funds for U.S. universities; the United Kingdom and West Germany were also major contributors. As a region, Western Europe accounted for $28.9 million, or 39 percent, of the foreign funds reported (Table 7).

University Policies on Foreign Funds

According to the GAO survey, university policies and practices in accepting or administering research funds generally do not distinguish between U.S. and foreign sponsors. Where there are differences, universities tend to place greater restrictions on foreign—rather than U.S.—sponsors. Differences cited by universities primarily involved the financial and legal provisions of funding research, and included the following:

- Imposing payment provisions, such as requiring advance payment of the full amount in U.S. dollars;
- Subjecting funding to greater overall scrutiny and/or to approval through different review channels than for domestic funding; and
- Ensuring that research agreements comply with U.S. export control regulations and other laws.

Industrial Liaison Programs

Many universities have established industrial liaison programs to increase industrial access (both U.S. and for-

Table 7. Foreign funds by country and region: FY 1986
(dollars in millions)

Country/Region	Dollars
Western Europe	$28.9
United Kingdom	7.0
West Germany	5.6
Other Western Europe	16.3
Far East	18.3
Japan	9.5
Other Far East	8.8
Middle East	7.9
Israel	0.7
Other Middle East	7.2
Other	17.5
Canada	5.7
Multinational	1.5
Other*	10.3

*For the top five universities receiving foreign funds, other included countries (Mexico, Poland, the USSR, and Tunisia).

SOURCE: GAO, "Foreign Sponsorship of U.S. University Research," 1988.

eign) to university research information. Liaison program membership benefits may include seminars, publications, interactions/consultations with faculty or graduate students, access to university facilities, access to student resumes, visits by faculty to corporate facilities, ability to help select research projects, and continuing education and industrial scholar programs. In return for these benefits, universities may charge a fee or request a contribution.

Thirty-eight percent (41) of the universities which reported receipt of foreign funding described three of their major industrial liaison programs. Of these, 70 percent (71) had been created since 1980; they had 2,848 U.S. member companies (85 percent) and 496 foreign member companies (15 percent). Information on the amount of money contributed by foreign sources to these liaison programs could not be determined.

Three universities—Texas A&M, MIT, and the University of California at Berkeley—accounted for 76 percent of the foreign membership reported. Their programs were all university-wide and were in the areas of thermodynamics, oceanography, chemistry, transportation studies, materials processing, and engineering. The relevant Texas A&M liaison program did not charge an annual fee. MIT identified 116 foreign members in its university-wide liaison program; fees for this are based on company size and range from $25,000 to $100,000. A second MIT liaison program has 50 foreign members who pay an unspecified annual fee. The University of California at Berkeley reported 42 foreign members in an industrial liaison program; most of these had been granted membership by sponsoring research projects. Fees to join the liaison program at Berkeley begin at $5,000.

Foreign Endowments and Gifts

Of the 134 responding universities, 20 reported having received over $500,000 in accumulated gifts or endowments for R&D programs, facilities, and/or equipment from any single foreign source since the beginning of FY 1984. The gifts and endowments identified totaled $27.3 million. Japan accounted for the largest number of these—12—followed by Canada with three; Switzerland, Spain, Italy, Israel, Peru, and Somalia also provided gifts or endowments. The Japanese gifts and endowments were for imaging in the arts and media; equipment purchase or facilities construction; support of a faculty chair and of a center of Japanese business and economics; research on fisheries; legal restrictions in the Pacific Community; construction technology; and radiology; and fellowships.

V. FOREIGN SCIENTISTS AND ENGINEERS IN U.S. BEYOND UNIVERSITIES

FEDERAL LABORATORIES

Federal laboratories represent a vital R&D resource: performing research in a broad range of fields to meet national objectives and priorities. In 1986, the Federal Government obligated $18 billion for R&D to these laboratories. To determine the extent of foreign participation at these laboratories, the GAO surveyed 52 laboratories in 7 Federal agencies (GAO: "U.S. and Foreign Participation in R&D in Federal Laboratories," 1988). These agencies—the Departments of Agriculture (AG), Commerce (DOC), Defense (DOD), Energy (DOE), Health and Human Services (HHS), and Interior (DOI), and the National Aeronautics and Space Administration (NASA)—together accounted for about 95 percent of the funds obligated for Federal laboratory R&D. The individual laboratories selected for inclusion in the sample were among each agency's largest and were more likely to conduct R&D in fields with commercial potential.

Fifty Federal laboratories responded to the survey. These employed 49,902 researchers, had a combined R&D operating budget of $14.1 billion in FY 1986, and included the major Federal laboratories involved in R&D with commercial potential.

Federal laboratories offer a variety of programs through which foreign (as well as U.S.) governments, businesses, universities, and other nonprofit organizations can collaborate on or fund R&D. The principal mechanisms for such interaction are (1) guest and visiting researcher programs, which enable senior researchers from outside organizations to collaborate on a project with a colleague at the laboratory; and (2) educational programs, which bring postdoctoral fellows, faculty, and students to the laboratories to gain experience and/or training in a research field. About 19,000 outside researchers participate per year through these programs. The benefits of these programs are mutual; in fact, several laboratories rely on outside researchers (both U.S. and foreign) to supplement their permanent staff. For example, one-half of the foreign researchers participating in R&D at the National Institutes of Health (NIH) were postdoctoral fellows who received training for careers in medical research. Only about 10 percent of the fellows receive full-time positions at NIH.

Through these programs, 5,677 foreign researchers—representing 40 percent of all outside researchers—conducted R&D at the surveyed Federal laboratories in FY 1986.

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Distribution of Foreign Researchers

The majority of the foreign researchers conducted R&D at either NIH (34 percent) or the nine DOE energy research laboratories (32 percent). The next largest proportions worked at DOE's defense programs laboratories (9 percent) and NASA laboratories (8 percent). The fewest number of foreign researchers were involved in work at Air Force and DHHS laboratories (1 percent each).

Of all laboratories surveyed, only NIH and the U.S. Geological Survey had more foreign than U.S. outside researchers at their laboratories (52 percent and 65 percent, respectively). The majority of U.S. outside researchers were concentrated in DOE energy research laboratories.

Country of Origin

The largest number of foreign researchers came from Japan (758, or 13 percent of all foreign researchers). Of these, over one-half (394) worked at NIH; an additional one-quarter (191) worked at DOE's energy research laboratories. Similar priorities were reflected by the 448 researchers from the United Kingdom; most (33 percent) worked at NIH, while just over one-quarter were at DOE's energy research laboratories.

The next largest proportion of foreign researchers (8 percent) came from the People's Republic of China. Of these, 41 percent conducted research at DOE's energy research laboratories, 30 percent worked at NIH, and 15 percent were at the National Institute of Standards and Technology (NIST).

Priorities among the remaining groups of foreign nationals shifted between energy and medical research. West German researchers were concentrated at DOE's energy research laboratories (42 percent), with just under one-quarter more at NIH, and 11 percent at NASA's laboratories. Indian researchers, on the other hand, focused on NIH research (42 percent), with an additional 27 percent at DOE's energy research laboratories, and 12 percent at NASA laboratories. Researchers from the Soviet Union and other Eastern European countries were concentrated at both DOE energy research laboratories (39 percent) and NIH (34 percent).

Institutional Affiliation

Of the 2,953 foreign guest and visiting researchers, 57 percent were affiliated with universities and other nonprofit organizations. Twenty-five percent were government-affiliated; another 118 (4 percent) were affiliated with businesses; these were generally guest researchers. Parent companies or sponsoring professional organizations or trade associations paid researchers' salaries, housing, and other costs.

In addition to collaborating with researchers who conducted R&D through guest and visiting researcher programs, employees at Federal laboratories frequently work with their agencies' contractors. Forty laboratories reported that 908 foreign researchers employed by a Federal contractor conducted R&D at the laboratories to fulfill contract terms. NASA laboratories reported that 334 foreign researchers worked as contractor personnel in FY 1986.

Foreign Participation by Program Type

Japanese nationals were the most heavily represented in both guest and visiting researcher programs (13 percent) and educational programs (15 percent). Among Japanese guest and visiting researchers, 33 percent worked at NIH, and 36 percent worked at DOE's energy research laboratories.

Nine percent of the foreign participants in guest and visiting researcher programs came from the United Kingdom, 8 percent were from West Germany, and 25 percent came from other Western European countries. Overall, 403 Western European researchers worked at NIH, 489 worked at DOE's energy research laboratories, 265 worked at DOE's defense programs laboratories, 145 worked at NASA, and 224 worked at other surveyed laboratories.

Among program participants from the People's Republic of China, 131 worked at DOE's energy research laboratories, 56 worked at NIST, and 48 worked at NIH.

Among educational program participants, Japan had, as stated, the highest proportion with 10 percent; India had the second highest. Regarding participants in educational programs overall, 10 percent of the university and high school faculty members and of the graduate, undergraduate, and high school students who worked at Federal laboratories in FY 1986 were foreign nationals. Similarly, 41 percent of all postdoctoral fellows conducting research at Federal laboratories under educational programs were foreign nationals; of these, 73 percent worked at NIH.

The likelihood that foreign researchers participating in educational programs will seek U.S. citizenship apparently varies by nationality. Japanese researchers typically will return to Japan; a higher percentage of researchers from India (for example) will seek U.S. citizenship.

U.S. INDUSTRY

Current S/E Work Force

In 1986, there were more than 1.6 million employed scientists and 2.2 million employed engineers in the U.S.; together, these represented about 4.6 percent of the national work force. Between 1976 and 1986, the Nation's S/E work force nearly doubled, increasing four times as rapidly as total U.S. employment.

Overall, the S/E work force grew at an average annual rate of 6.4 percent per year since 1976; there was, however, substantial variation across fields. Employment of scientists increased at a faster rate than that of engineers: 7.1 percent per year versus 5.8 percent. Almost 20 percent of the increases among scientists were due to growth in the employment of computer specialists; a

computer specialists are excluded, employment growth for scientists averaged only 5.5 percent per year. Among engineering subfields, the largest relative employment growth was in electrical and astronautical/aeronautical engineering.

S/E Employment by Sector

Industry. In 1986, industry was the major employment sector for both scientists and engineers, employing 66 percent (almost 2.6 million) of the S/E work force. Engineers were more likely than scientists to work in industry—80 percent of engineers, versus 48 percent of scientists, were so employed. Between 1976 and 1986, total industrial S/E employment increased an average of 3 percent per year, rising from 1.3 million in 1976 to almost 2.6 million in 1986.

Increases in industry's share of the S/E work force become more pronounced at the doctoral level. Although educational institutions remained the primary employer of doctoral scientists and engineers in 1985, the proportion employed in this sector had declined steadily since the early 1970's, while the industry share increased. In 1973, 59 percent of all S/E doctorate-holders were in educational institutions and 24 percent were in industry; in 1985, these proportions were 53 percent and 31 percent, respectively.

Another trend in industry sector S/E employment was a gradual shift from the manufacturing to the non-manufacturing sector, with the proportion of scientists and engineers in manufacturing industries declining from over 57 percent in 1977 to about 55 percent in 1986. By 1986, about 45 percent of all industrial scientists and engineers were employed in non-manufacturing industries.

Much of the increase in S/E employment in the non-manufacturing sector can be attributed to the rapidly expanding work force of the service industries. Changes within manufacturing, however, are almost entirely explained by structural change. While manufacturing experienced little or no growth in total employment levels between 1977 and 1986, science and engineering employment increased by an average of 4.9 percent per year—primarily because of the increased dominance of engineers, computer specialists, and mathematical scientists. The labor-intensive production of the seventies shifted to the more high-tech and knowledge-intensive environment of the eighties.

Academia. With just under 15 percent (almost 573,000) of the S/E work force, academia ranked a distant second to industry as an employer of scientists. 29 percent of all scientists were in the education sector, but only 4 percent of all engineers. Of the scientists and engineers employed by academia, almost 84 percent were in scientific fields; one-half of these were either life scientists or social scientists. Of the 91,300 engineers in the sector, 25,000 (27 percent) were electrical/electronics engineers and 17,000 (19 percent) were mechanical engineers.

Over the 1976–86 decade, academia's share of the S/E work force increased from 13 percent to almost 15 percent. The ratio of scientists to engineers remained constant at about six to one. In general, academia experienced the same increasing demand for scientists and engineers as did industry; this demand was especially pronounced for those with engineering or computer science degrees. Moreover, because some universities in the early 1980's were unable to compete with salaries offered by private industry, they lost faculty members in certain high demand engineering positions.

Federal Government. The Federal Government ranked as the third largest employer of scientists and engineers in 1986, accounting for about 9 percent of S/E employment. Over 54 percent of the 334,200 Federal S/E work force were in engineering occupations; almost one-half were in either electrical/electronics or civil engineering. Among Federally employed scientists, 26 percent (40,200) were in the life sciences and 21 percent (32,100) were computer specialists. Almost one-half of the Federal scientists and engineers were employed by DOD. AG had the second highest share with 12 percent.

Other Sectors. Of the remaining 10 percent of the employed S/E work force (425,700), almost one-half worked for State and local governments, 34 percent were employed by nonprofit institutions, and 16 percent were in the military or other organizations in 1986.

Demand for Scientists and Engineers

As of 1986, there appeared to be a rough balance between the supply and demand for science and engineering personnel; employment indicators suggested generally sufficient demand to accommodate the S/E work force. This is demonstrated by both a high labor force participation (94.5 percent) and a low unemployment rate (1.5 percent) for scientists. Furthermore, in a 1985 survey, industrial employers reported low levels of shortages; this also indicates that the Nation's science and engineering labor force is, in general, sufficient to meet the economy's current demands.

One exception to this supply/demand equilibrium is the demand for engineering Ph.D.'s. In 1986, engineering schools reported shortages of faculty in that discipline, with almost 9 percent of authorized full-time engineering faculty positions unfilled. Industry employers reported shortages in electronics engineering, nuclear engineering, and electrical engineering.

Academic shortages for several other fields are reported in a 1988 National Council of Education survey. About six in ten colleges and universities reported shortages of faculty in computer sciences. Although every type of institution was affected, shortages of computer scientists were especially severe among doctoral institu-

tions, where 86 percent reported inability to fill vacant faculty positions. This survey also indicated that one-third of all institutions were unable to fill vacant positions in mathematics, with public institutions more likely than independent institutions to report such difficulties.

Lacking graduate candidates to fill these academic positions, educational institutions have increasingly relied on foreign scientists and engineers to maintain their staffing levels. U.S. industry also reports reliance on foreign scientists and engineers. A 1985 survey of 300 U.S. firms showed the dependence of U.S. industry on foreign scientists and engineers. In firms employing foreign citizens, these personnel made up an average of 9 percent of the firms' S/E work force. An additional 11 percent was of naturalized U.S. citizens (see Chart 6).

To assess the quality impacts of foreign engineers in U.S. industry, a survey was carried out of 20 members of the Industrial Research Institute (IRI) and discussions were held with top-level managers in the industrial R&D community (Peter Cannon: "Foreign Engineers In U.S. Industry," in *An Exploratory Assessment: Foreign And Foreign Born Engineers In The United States*, National Academy Press, 1988). Results confirmed that foreigners comprise a significant segment of the engineering work force in U.S. industry.

In comparing foreign engineers to their U.S. counterparts, preparation, skills, and professionalism were found to be about equal, with poor communication skills noted as the major drawback of foreign engineers.

The author recommended that the artificial barriers to entry into the United States of foreign engineers must be lowered. U.S. demographic and market needs make it urgent to simplify current immigration regulations so as to make it easier for American industry to employ foreign-born graduate students.

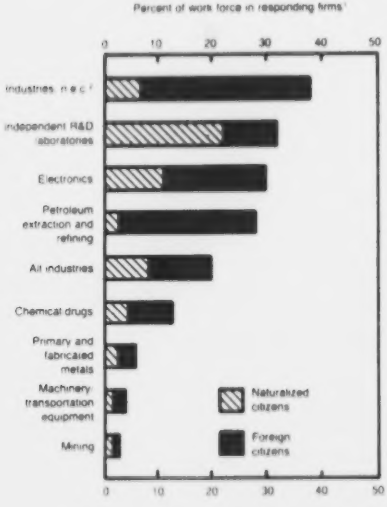
Encouraging more Americans to enter science and engineering careers through major reform and strengthening of the U.S. educational system was also recommended. Monitoring the propensity of foreigners to remain in the United States was suggested so as to anticipate the problem that would arise should significantly more foreigners choose to return to their countries.

To supplement these 1988 results, in January 1989, several of the highest R&D funding companies in the United States were asked about the nationality of newly hired and already employed scientists and engineers over the last few years. Responses indicate an average of about 10 percent of newly hired scientists and engineers were foreign citizens, and approximately 8 percent of the research work force.

As the above illustrates, the balance between supply and demand for S/E personnel is being accomplished through means other than production of new science and engineering graduates. Educational institutions have increasingly relied on foreign scientists and engineers to maintain their staffing levels. This is also true of U.S. research-intensive industry, although to a far lesser extent. Overall, between 1972 and 1982, native-born U.S. citizens declined from 90 percent of the S/E labor force to 83 percent; this also reflects an increasing reliance on foreign personnel to maintain the supply-demand equilibrium in the S/E labor market.

The balance between supply and demand for S/E personnel has also been accomplished through other means than employment of foreign scientists and engineers. One major source of supply is occupational mobility. For example, in the late 1970's, individuals with degrees in closely related fields (e.g., chemistry, physics, mathematics) filled the gap between job openings and new degrees in engineering and computer science. One consequence of this was that between 1972 and 1982, the portion of the engineering work force with degrees in non-engineering fields rose from roughly 15 percent to approximately 20 percent.

Chart 6. Foreign and Naturalized U.S. Citizens as Percent of Science/Engineering Work Force in Selected Firms by Industry: 1985



Data refer only to responding firms employing foreign citizens (chart 1).
²Not elsewhere classified. Includes aeronautical, construction, engineering and architectural services, and utilities.
Source: National Science Foundation.

Also, during this period, a large amount of reciprocal flow between engineering and computer specialists took place. Almost one half of the inflow to computer specialties from other occupations came from engineering and about one-tenth of the inflow to engineering came from computer specialties. Concern has sometimes been expressed about this type of mobility in that many computer specialties include practitioners who may not be fully trained engineers.

Another source of supply for scientists and engineers, particularly in industrial non-R&D activities, is the pool of non-degree technicians who are promoted on the basis of their experience. However, data are not available to indicate the proportion of the U.S. science and engineering work force that consists of such non-degreed individuals.

Overall, the U.S. research system shows a dependence on foreign scientists and engineers and this dependence is expected to continue.

Mr. BOUCHER. Thank you very much, Dr. Hancock. We appreciate your presence here today and that very concise statement this afternoon.

If we were to enact Mr. Henry's legislation, do you have any concern that we might be sending a signal to qualified students in other lands that perhaps they are not as welcome in the United States as they once were, and that there might therefore be some retarding of their willingness to come to this country and their eagerness to do so?

Dr. HANCOCK. My primary concern centers around two points. Not only would it increase the burden of paperwork on behalf of the universities, but I am more concerned about the signal that it sends to the universities. I spent 27 years in a large State, tax-supported university; that is, very large as far as science and engineering is concerned. I, as dean of the engineering programs of that university, was confronted almost on a weekly, monthly basis about the excess of foreign students. Taxpayers too are very sensitive in States about foreign students in their State universities. Somehow they perceive that they are paying the bill for education of foreign students only to have those students return home and perhaps compete with us on the international scene.

So I am concerned about the signal that it sends to these universities. I am concerned that a number of individuals in these universities are already apt to impose rules and regulations limiting these foreign students and this would just simply be another step or another signal to them that they are moving in the right direction. I think as a country we cannot afford a decrease in foreign students at this particular time.

Mr. BOUCHER. The goal should be not to decrease foreign participation, but to increase participation by American students.

Dr. HANCOCK. Absolutely.

Mr. BOUCHER. I think Mr. Henry has touched on a very important issue, and he has done a great service to us in bringing the matter before us in the manner that he has. We may differ about what the right solution is, but I think we all would agree that it is an important subject for our inquiry.

What is the right approach for us to take? What should we be doing, as policymakers, to stimulate broader interest on the part of American students in obtaining these graduate degrees?

Dr. HANCOCK. The Education and Human Resources Committee of the National Science Board has considered this area, this problem, for the last two years, I must say. We have broken it down into what we call a short-range and a long-range solution. The long-range means going all back through K through 12 and doing something of a very significant nature there. We in the Foundation think we are doing that and involving ourselves in working with States and school systems to try to bring about a change.

But on a more short-range, we've got to, I think, to address undergraduate education at the university level. I know in engineering large numbers of students come into engineering only to find out that about 50 percent or less are left, after four years, of those that entered the program—tremendous attrition—because they don't like engineering. It doesn't turn out to be what they thought it was going to be.

I think we have got to make these programs more attractive. I think they have got to be more exciting. I think we've got to have reform in the undergraduate program, both in science and engineering. And then I think we've got to effect programs which help to pull these students through from the undergraduate into the graduate level.

We at the National Science Foundation implemented a new traineeship program last year which the HR Committee is quite excited about. As you are aware, a great deal of our money, particularly in fellowships, go to only U.S. citizens. Traineeships would only go to U.S. citizens. And this is an attempt to get the faculty involved at the university level in working with those students at the undergraduate level and pulling them through.

Fellowships, as you know, a student receives an NSF fellowship, they can go anyplace they want in the United States. These are the brightest students we have. They migrate, of course, to those universities that are very well known in the field of science and engineering. We have, I am convinced, universities, facilities and faculty that are not adequately utilized as far as educating doctoral students are concerned. The traineeship program goes to a particular university. It does not give the student the ability to transport into another program, thereby, hopefully, interesting the faculty in working with students to pull them through to their particular programs and having a very positive effect as far as the number of U.S. citizens.

Mr. BOUCHER. I gather that in major part your answer suggests that we have a systemic problem and that we have to start looking further back than the college years in order to resolve it and upgrade the interest of young people in math and science education starting in the early grades.

Dr. HANCOCK. I absolutely agree with that, but that is a long-range solution to the problem.

Mr. BOUCHER. Let me focus on just two other questions, and then I will yield to my colleagues.

One of the suggestions that has been made is that perhaps there is some bias in favor of foreign graduate students and against American graduate students, at least at some universities. I want you to comment on that and weigh as you provide the answer the results of a report that the American Association of Universities published in 1991, with which you may be familiar, of some 140 universities across a range of disciplines in the technically oriented fields in graduate studies that suggest that 40 percent of the applicants for those degree-granting programs are U.S. citizens but 60 percent of those admitted to the program are U.S. citizens.

And, in light of those facts, assuming them to be accurate and reflective of what happens across the country as a whole, is there any kind of bias? Do you detect any kind of bias beyond the confines of this report?

Dr. HANCOCK. In 1988, I chaired a committee for the Board dealing with foreign involvement in U.S. universities, which you have a copy of that as part of my formal record. One of the questions we asked a large number of universities—departments—in natural sciences and engineering dealt with that very issue, as to their prefer-

ence and their sensitivity in getting more U.S. students involved in our graduate program. These were largely department heads.

They came back to us with a response which at that time I think was very clear. The bottom line of that response was there is no doubt that, if qualified students, U.S. students, are available, our preference would be to place those students on research assistantships, other forms of support which we have available. There was a clear indication of their preference to move in that direction versus the support of foreign student.

Now that is not to say that they want to take the number of foreign student down to zero. I don't think any of us agree that that would be a good thing for us. But there was a clear indication that given their choice they would move in this direction.

At that time I saw no evidence that there was a preference for foreign students. Most faculty want the brightest, most talented students that they can get. That is where their professional reputation is established. That is where the good research is carried out. And I must admit that, when it comes to the National Science Foundation and the research grants that we make to faculty, we have a two-pronged approach. Number one, we want to see Ph.D.'s out of that. Education is part of that grant, but good research is part of that grant as well. And therefore we stress to the faculty through our review process and our award process itself that we want good, the very best research that you can do under this grant. Consequently, they go after the most talented students. So I think you see some of it there simply from a sorting out of the talent.

Mr. BOUCHER. That is a very thorough answer.

Finally, and this is an important consideration for us, what costs do you think would be imposed upon universities if the legislation as proposed were enacted and they were required to comply with the certification and other kinds of requirements that the bill contains? And I am particularly concerned about requirements such as having to certify before any kind of Federal support is provided to a foreign graduate students that there were no qualified American graduate students who could hold that position. What kinds of costs do you foresee? And, if you can quantify that in dollar terms, that would be very helpful as well.

Dr. HANCOCK. Mr. Chairman, I have difficulty putting a dollar figure on that. I have been out of academia for some seven or eight years now, and while the answers I give would draw on my background as far as the number of people would be involved and the like, I think I would prefer to pass on that one, simply because I don't know my numbers would be that meaningful to you.

Mr. BOUCHER. All right. We will ask that question of the next panel.

Dr. HANCOCK. All right.

Mr. BOUCHER. Thank very very much, Dr. Hancock.

The gentleman from California, Mr. Packard?

Mr. PACKARD. Thank you, Mr. Chairman. I will limit my questions and allow my colleague from Michigan to have, perhaps, additional time for questions.

The National Science Board has been making the recommendation since the 1989 report that involves foreign students and recommending we give high priority to our own U.S. students. Yet it

seems like our progress has been very slow in that direction. Why? And what is being done to maybe hasten the implementation of the recommendations that have been in existence now for almost four years?

Dr. HANCOCK. Well, I think there's a number of programs in place. These programs not only work with what I would call the mainstream kind of students that go into science and engineering and on into graduate programs, but also attempts to deal with the minority issue as well. Several special programs are in place all the way from precollege through college up through the graduate level that point directly towards minorities because they are underrepresented as a group when you talk about science and engineering. And, while there has been some improvement in that area, it certainly is not as substantial as I am sure we would all like.

I personally have given a lot of thought to this minority issue and dealt firsthand with it when I was in the university and industry, responsible for the hiring of a substantial number of graduates. And in engineering back during the late '70s—early and late '70s, there were significant efforts put on attracting women into engineering. Now that met with a great deal of success. And you look at the number of women that have come into engineering, and there have been a substantial improvement there.

The women issue is different than the issue of other minority groups. And I think that there is a great deal that needs to be done—yet to be done as far as the minority groups are concerned. I think there are many programs that are in place that given a chance to work and given time to work and function, they will accomplish an increase in the S&E enrollment.

Mr. PACKARD. Fine. Thank you very much, Mr. Chairman.

Mr. BOUCHER. The gentleman from Michigan?

Mr. HENRY. Thank you, Mr. Chairman. And again, Dr. Hancock, I appreciate the tenor of your testimony. I really think what we have to do, though, is to zero in, I think, on the question a little more particularly. Because it clearly is not my attempt to try to erect barriers between our universities and the outside world or discourage universities from accepting foreign student, and I do recognize, as the Chair pointed out and as you confirmed, I think, we are all well aware in this committee that the problem is systemic and reaches well beyond just this little slice. The particular thing we're talking about is a symptom of a greater problem in terms of the way we're educating kids and moving them out, and career opportunities that are available in the private sector.

But let me begin with this question. With all things being equal, and this is not an issue of black versus white or Oriental versus Caucasian. Let's say we are talking about a Japanese-American versus a Japanese student or, let's say, a black American from one of the historically black institutions that is applying for a graduate program as opposed to a graduate student coming from the University of Lagos.

Dr. HANCOCK. University of?

Mr. HENRY. Of Lagos. So, you know, it's black-black, Oriental-Oriental. I'm just trying to get the racial issue out completely.

So we're focusing simply—or, you know, a student from Chicago who is an American national competing against a student from

Prague, white-white. All things being equal, level of preparation, level of ability, appropriateness for the project at hand, ought the admitting institution give preference to the American national as opposed to the non-national, given the fact that obviously Federal research dollars in institutional support and student support is always going to be limited? As a matter of policy, if all things being equal—I'm insisting all things being equal—is there anything wrong with saying an American student would have preference over the non-American student?

Dr. HANCOCK. I think that every university has got to establish goals as far as the S&E enrollment is concerned when it comes to the makeup of the student body. I would not like to see universities give complete preference to U.S. citizens with the exclusion, let's say, a hypothetical case, of total—the lack of any involvement of U.S., or of foreign students.

What I am trying to say is this. Is that I think there's a right mixture as far as S&E programs are concerned, U.S. citizens, foreign-born students. I think for an educational experience of our students, the U.S. students, there need to be involvement of foreign student in that program.

Mr. HENRY. You are saying and if it's all things being equal the American student ought not necessarily be granted preference—all things being equal?

Dr. HANCOCK. No, that's not what I'm saying. I'm saying that if there is a goal that the mixture of students ought to be, let's say, 80-20 or 75-25, somewhere in that realm, that's got to be taken into account as far as the admission policy is concerned.

Now, assuming those goals can be reached without any finagling of the numbers and the like because you have an ample body of students, both U.S. citizens and foreign-born, then I think that for many of the State universities, the one that I was from particularly, would give a preference to the U.S. citizens.

Mr. HENRY. It strikes me that most of your graduate schools would be trying to get a better proportion of American students in the first place, so you would be leaning even more in the direction, I am suggesting, because the legislation only says all things being equal.

Why is it that of our graduate students who are receiving institutional aid, of the foreign graduate students somewhere around 70 percent, I think 68 percent are receiving institutional support. But of American students, only 40 percent are receiving institutional support. Why is it that the ratio of foreign students receiving institutional support at the graduate level is some 50 percent higher above that ratio of American students?

Dr. HANCOCK. Mr. Henry, I don't have an answer for you on that. I've seen the tables. I've seen the numbers, and I have some questions as to how that data was collected. Certain categories pertaining to self-supporting—did they have to go out and borrow the money to be self-supporting and on and on. And I just simply have not examined that data in enough detail to give you an answer to that question that I feel competent.

Mr. HENRY. In the last paragraph of your testimony you suggest the title of this bill is itself a misnomer "because discouraging enrollments of international students would do nothing to encourage

or support American students to study math or science." How does this bill discourage enrollments of international students?

Dr. HANCOCK. I feel that by the bill itself and putting into place in the universities a mechanism of reporting on foreign student and justifying, because that's what the bill calls for, justifying—Why did you give Federal support to this particular foreign student?—I think that particular message sends a negative message to the universities as far as foreign student are concerned and the use of Federal dollars. That sends a message to them that there's something wrong. There's something bad about—

Mr. HENRY. Isn't that a reasonable request, if in turn you can't tell me as a former chairman of the National Science Board why the disparity exists that, well, a 50 percent greater ratio of foreign students are getting institutional support vis-a-vis American students? I mean I guess that's the dilemma. And, to what extent that pattern may in fact discourage undergraduate students from going on into graduate work in the sciences because the likelihood of their ability to get a research assistantship is less than half, whereas for a foreign student is better than 2 out of 3. And I guess that is what I am trying to address.

Dr. HANCOCK. Mr. Henry, my understanding is and my feeling is that there are not those qualified U.S. undergraduate students that want to go on into graduate work that are not doing so because there is no money available—there is no research assistantship money available. I just simply don't have that impression as I associate with my colleagues.

My understanding is that when those U.S. citizens are available, they want to go into graduate work and the professor has money to support them, they will support those students. The impression that they would rather go abroad and bring a student over in place of one of the U.S. students, I simply don't agree with that. I don't have that impression of that's what's going on in the university environment.

Mr. BOUCHER. Mr. Henry, we have a recorded vote. Do you have any further questions of Mr. Hancock?

Mr. HENRY. No. That's fine. I thought I'd try to finish.

Mr. BOUCHER. Mr. Hancock, we're going to recess the subcommittee just for about 10 minutes while we respond to a call of the House. We have completed our questions of you, and thank you very much for your attendance here today. You've been very helpful to us.

Dr. HANCOCK. Okay. Thank you.

Mr. BOUCHER. The subcommittee stands in recess.

[Recess]

Mr. BOUCHER. The subcommittee will reconvene.

And we welcome now our second panel of witnesses for this afternoon: Mr. Jules LaPidus, the president of the Council of Graduate Schools and representing the Association of American Universities; Dr. Frank Morris, the dean of graduate studies at Morgan State University, Baltimore, Maryland, and president of the Council of Historically Black Graduate Schools; Dr. William Powers, Provost of Michigan Technical University in Houghton, Michigan; and Dr. Stanford Penner, p.ofessor of applied mathematics and engineering sciences at the University of California, San Diego, and

chairman of the National Academy of Sciences Committee on the International Exchange and Movement of Engineers.

Gentlemen, we welcome each of you today. Without objection, your prepared statement will be made a part of the record. We would encourage that your oral summaries be contained to five minutes so that we'll have plenty of time for questions.

And, Dr. Powers, let's begin today with you.

STATEMENTS OF JULES B. LaPIDUS, PH.D., PRESIDENT, COUNCIL OF GRADUATE SCHOOLS, REPRESENTING THE ASSOCIATION OF AMERICAN UNIVERSITIES, WASHINGTON, D.C.; FRANK MORRIS, PH.D., DEAN OF GRADUATE STUDIES, MORGAN STATE UNIVERSITY, BALTIMORE, MARYLAND, AND PRESIDENT, COUNCIL OF HISTORICALLY BLACK GRADUATE SCHOOLS; WILLIAM POWERS, PH.D., PROVOST, MICHIGAN TECHNOLOGICAL UNIVERSITY, HOUGHTON, MICHIGAN; STANFORD S. PENNER, PH.D., PROFESSOR OF APPLIED MECHANICS AND ENGINEERING SCIENCES, UNIVERSITY OF CALIFORNIA, SAN DIEGO, SAN DIEGO, CALIFORNIA, AND CHAIRMAN OF THE NATIONAL ACADEMY OF SCIENCES COMMITTEE ON THE INTERNATIONAL EXCHANGE AND MOVEMENT OF ENGINEERS

Dr. POWERS. Mr. Boucher, Mr. Henry, thank you for the opportunity to testify.

I understand that it is the intent of this legislation to underscore the dilemma we face in conducting funding research in science and engineering. To carry on this research, it has become necessary for universities to engage large numbers of non-resident alien researchers, and thus U.S. tax dollars are used to support graduate students, some of whom do not contribute here after graduation but instead return to their native countries.

But the dilemma is that the number of funded graduate assistants—citizens, resident aliens and non-resident aliens—is the number necessary to sustain research in science and engineering at its present level in U.S. universities. It's not that we have too few or too many engineers or scientists or the predictions about future needs may not be accurate. It's that the graduate research assistants, U.S. and foreign born, engaged in present research are a necessary number to do the work.

The obvious need, as you have heard and will hear again, is to increase the number of U.S. citizens in the pool from which graduate students are drawn. It's to improve the ability of U.S. citizens in mathematics and science.

There are a number of highly successful programs that bring students success in science and mathematics. You probably know about the Uri Treisman conceived approach to university—level learning communities in mathematics. You know about the work at the secondary level led by the foundation, Ventures in Education, which is a development of an earlier Macy Foundation program to prepare students for university admissions in science and mathematics.

There are also a number of successful college and university collaboration. We have had success of our own at Michigan Tech with learning centers in writing, mathematics and chemistry, with a col-

laborative learning program in calculus that we call The Emerging Scholars program. We also conduct a program of cooperation in mathematics instruction with schools in our region. We have summer programs for precollege women and for minorities in engineering. We have participated in NSF-funded programs to engage undergraduates in research, and we participate in State of Michigan programs extending to the seventh and eighth grades, including the Wade McCree Scholarship Program.

These have been successful undertakings for us. We have seen the university retention rate rise from about 50 to more 65 percent. This is a very high figure for a university in which some 90 percent of the students are enrolled in programs in science or engineering. We stand 13th in the Nation in the enrollment of women in our undergraduate engineering program, and although our total number is small, we have doubled the number of minority students in the last three years.

The programs we are carrying out and related programs at other universities demonstrate two things:

First, they work. The preparation of students in science and mathematics can be improved. These programs work at every level, primary, secondary, and university.

Second, they work for students whom we have not reached in the past. These programs address the issues of women, minorities and students who have not succeeded traditionally. They also serve the white male student from a rural school or from a poorly funded school who has weak preparation.

But these programs are all modest in size. While they prove a principle, they have not yet brought significant change to the size of the pool of U.S. citizens available to sustain a necessary level of federally funded research in science and engineering, and I ask that the committee again consider that point. The dilemma is not so much that there are too many non-resident aliens performing research. It is that the research is necessary and that there are too few U.S. citizens prepared to do it.

Information about programs that work is hard to obtain, programs come and go, efforts are duplicated, and funds are scarce. Despite frequent discussion, there seems not to be much agreement on how to proceed with the development of programs to build the pool, nor much urgency in the sense that universities should be widely engaged in that activity. There is a strong need for awareness of what can be done to improve education in science and mathematics, and also for university participation at every level in that improvement.

If this bill can contribute to awareness by universities and by faculty in science and engineering that shortages of well-prepared citizens are significant, not in general, but to each university engaged in federally funded research, if it can contribute to bringing universities to the aggressive development of programs to improve education in science and math at every level, then it will be useful legislation.

Thank you.

[The prepared statement of Dr. Powers follows:]

William Powers
Provost
Michigan Technological University
Houghton, MI 49931

Testimony for the Subcommittee on Science of the House Science, Space, and Technology Committee

I thank the committee and its chair, Congressman Boucher, for this opportunity to testify. I share the concern articulated in this bill, the American Math and Science Student Support Act.

As I understand the bill, there are five requirements:

1. Universities will be required to report the name and country of origin of each non-immigrant alien employed as a research assistant under a federal grant program.

2. Universities will be required to provide a statement of intention for each non-resident alien with respect to the seeking of permanent resident status.

3. Universities will be required to describe their efforts to hire U.S. citizens or permanent resident aliens to conduct their research and development activities.

4. Universities will be required to certify that despite their efforts no qualified citizen or permanent resident alien is available.

5. Universities will be required to report every five years on the amount of government and non-governmental financial assistance provided to foreign students.

I further understand that it is the intent of this legislation to underscore a dilemma we face in conducting federally funded research. That dilemma is that to carry on the present level federally funded university research in science and engineering, it has become necessary for universities to engage large numbers of non-resident alien researchers, and thus U.S. tax dollars are used to support graduate students some of whom do not contribute here after graduation but instead return to their native countries.

The committee will have heard objection to the fact that the bill requires preparing reports. I express my own reservation at this feature, especially on behalf of my deans who are burdened by forms and reports.

But I reserve the bulk of my testimony to address the dilemma and its implications. I believe the committee has heard testimony questioning the NSF predicted shortfall in numbers of needed engineers and scientists for the next

century. I would like to call the attention of the committee away from the issue of predicted numbers and direct it toward another part of the problem.

Predictions of shortfall in numbers of scientists and engineers grow partly from the assumption that future growth in the economy will be dependent upon an ever growing number of scientists and engineers as persons whose work will feed growth. However, a painful lesson of the last twenty-five years has been that the capacity to do good science and engineering is not at the root of weakness in the manufacturing segment of our economy and in the associated basic weakness in the economy. This weakness is consistently attributed not to our failure to secure breakthroughs in science or technology; it lies in our failure to bring those breakthroughs effectively into the marketplace; it is a failure in manufacturing. Thus I do not associate weakness that must be addressed in the national economy with shortages of scientists and engineers, and I am inclined to distrust predictions of future shortfall in these areas not because there may not be shortages but because to this point our problem does not seem to have been an inadequate number of persons doing science and engineering. It has been an inability to seize on the outcomes of that work.

At the same time, however, if I mistrust the predictions of future shortfalls, it is important to ask about the size of the present pool. Research in science and engineering is commonly performed by students working under the direction of faculty. The active participation of these students is essential to the work. This is a vital concept. A doctoral student working as a funded research assistant in a laboratory is a person engaged directly in the active research of that laboratory. The principal investigator or project director may supervise the research, and in the complexity of today's disciplines, the principal investigator is probably the person who has put together an interdisciplinary team to carry out the work, but that principal investigator is not in the laboratory as a scientist who is teaching novices. A substantial body of vital work will be done by those graduate assistants. Their role in the laboratory may be more like that of a physician carrying out a residency in a hospital than it is like a graduate student in another disciplinary area like the humanities.

Thus the dilemma is that the number of funded graduate assistants, citizens, resident aliens, and non-resident aliens, is a number necessary to sustain research in science and engineering at its present level in U.S. universities.

The obvious need is to increase the number of U.S. citizens in the pool from which graduate students are drawn. It is to improve the ability of U. S. citizens in mathematics and science. One significant outcome of this legislation should be to give universities the impetus to undertake programs that will draw more American students toward mathematics and science.

There are a number of highly successful programs that bring students to success in science and mathematics. Perhaps the best known of these university programs is the Uri Treisman conceived approach to learning communities in mathematics. In secondary schools, a program that is especially distinguished by its success is that led by the foundation Ventures in Education, a development

of an earlier Macy Foundation program to improve preparation in science and mathematics. The mission of Ventures in Education is to lift the academic performance of minority and economically disadvantaged high school students, enabling them to meet the admissions requirements of selective major colleges and universities.

There are also a number of successful college and university collaboratives. The Alliance for Undergraduate Education is a gathering of fifteen research universities working to improve undergraduate programs especially in science and mathematics. Kaleidoscope is a similar association of liberal arts colleges. There is also the Council for Undergraduate Research, a society for the advancement of scientific research at primarily undergraduate colleges and universities. Each of these groups supports the enlargement of that pool of students well prepared in mathematics and science to continue on in graduate studies and research.

We have had success of our own at Michigan Tech with learning centers in writing, mathematics, and chemistry, and with a collaborative learning program in calculus that we call The Emerging Scholars program. We also conduct a program of cooperation in mathematics instruction with schools in our region, we have summer programs for pre-college women and minorities in engineering, we have participated in NSF funded programs to engage undergraduates in research, and we participate in State of Michigan programs extending to the seventh and eighth grades, including the Wade McCree scholarship program.

These have been successful undertakings for us. We have seen the university retention rate rise from about fifty to more than sixty-five percent, a high retention figure for a university which some ninety percent of the students are enrolled in programs in science or engineering. We stand thirteen in the nation in the enrollment of women in our undergraduate engineering program, and although the total number is small, we have doubled our enrollment of African American students.

The programs we are carrying out and related programs at other universities demonstrate two things:

1. They work. The preparation of students in science and mathematics can be improved. There are programs that work at every level, primary, secondary, and university. They improve the retention of students in science and engineering at universities, they increase the numbers of successful students in secondary schools, and they address the issue of the great weakness in American education in present small numbers of students able to serve as a resource in science and engineering.

2. They work for students whom we have not reached in the past. These programs address the issue of women, minorities, and students who have not succeeded traditionally. They also serve the white male student from a rural school or from a poorly funded school who has had little preparation in science and mathematics.

They are good programs for the university because they contribute to the

overall quality of our student body, not to a segment of it.

But these programs are all modest in size. While they prove a principal, they have not yet brought significant change to the size of the pool of U.S. citizens available to sustain a necessary level of federally funded research in science and engineering, and I ask that the committee again consider that point: the dilemma is not so much that there are too many non-resident aliens performing research; it is that the research is necessary and that there are too few U.S. citizens prepared to do it.

Information about programs that work is hard to obtain, programs come and go, efforts are duplicated and funds are scarce. Despite frequent discussion, there seems not be to much agreement on how to proceed with the development of programs to build the pool, nor much urgency in the sense that universities should be widely engaged in that activity. There is a strong need for awareness of what can be done to improve education in science and mathematics and for university participation at every level in that improvement.

If this bill can contribute to awareness by universities that the shortage of well prepared citizens is significant not simply to the country in general but also to each university engaged in federally funded research, and if it can contribute to bringing universities to the aggressive development of programs to improve education in science and mathematics at every level, then it will be useful legislation.

Mr. BOUCHER. Thank you, Dr. Powers.

Dr. Penner, we welcome you today.

Dr. PENNER. Thank you. I appreciate the opportunity to be here, Mr. Boucher and Mr. Henry.

I would like to begin by saying that the bill that is under discussion has a laudable goal that all, all of us, I am sure, support. Certainly the National Academy of Engineering Committee that I chaired a few years ago started with exactly this same goal: What must be done in order to increase participation in the physical sciences, in mathematics, and in engineering by U.S. citizens?

Our studies clearly showed that we currently profit from, and will continue to require for some years to come, the services of foreign and foreign-born engineers. They are essential participants in industrial research, in development and manufacturing, and in university research and instruction. Without their participation, the country would suffer serious constraints in essential activities that have immediate bearing on competitiveness in international markets and on the economic well-being of our citizens.

Now, the question of how to resolve the deficiencies, I believe that I am simply going to repeat what other speakers have already said. The deficiencies at the higher educational levels, insofar as the numbers of American students are concerned, are in large part the result of problems created by the lack of adequate instruction at lower grade levels. There is a very large pool of potential participants who are not now properly motivated to seek careers in mathematics, science or engineering, especially among women and members of minority groups.

We in our committee made some recommendations that dealt with specific problems in particular fields of engineering. We suggested, for example, that one could increase the stipends of engineering graduate students above those in other fields in order to divert more of the limited number of graduate students to these particular fields. That has been done, I think, to a very limited extent only.

We also suggested the addition of new and attractive fellowships restricted entirely to U.S. citizens. There have been some positive responses to this recommendation, but clearly the total funds available for stipends of all types have not grown adequately.

I'd like to say a few words about admission priorities. I believe that there is no question that admission priorities for graduate research currently used by research universities are so heavily biased in favor of American applicants that only exceptionally qualified foreign applicants can pass existing barriers to their admission. I do not believe that it would serve the national interest to diminish the training and immigration of exceptionally well-qualified students from foreign lands who are the only ones among a huge pool of applicants who achieve success in gaining admission ultimately.

I would like to—I will not comment on the rest of my prepared document because that is available to you. I would like to point out, however, that I have asked Chancellor Atkinson of the University of California at San Diego and Chancellor Chang-Lin Tien of the University of California at Berkeley to prepare formal statements commenting on this bill. These statements are appended to

my testimony, and from these statements I would like to quote only two remarks.

One is a statement of the cost, Mr. Chairman, about which you asked before. An evaluation was done on our campus to try to see what the annual cost would be of responding to the enactment of this law, and Chancellor Atkinson's estimate is $150,000 per year on the UCSD campus.

The second statement I would like to read is from Chancellor Tien. This is a verbatim quote. "Like most American universities, the University of California does not recruit foreign student. The one category that we do recruit vigorously is American minority applicants."

Thank you.

[The prepared statement of Dr. Penner follows:]

Statement of

S.S. Penner

Professor of Engineering Physics, Emeritus,
University of California at San Diego

on

H.R. 4945, The American Math and Science Student Support Act

before the

Subcommittee on Science
Committee on Science, Space and Technology
U.S. House of Representatives

April 29, 1992

Comments on H.R. 4595, the "American Math and Science Student Support Act"

by

S.S. Penner[1]

Chairman, National Academy of Engineering (NAE) Committee on
"The International Exchange and Movement of Engineers, 1986-87"
[see Foreign and Foreign-Born Engineers in the U.S.,
National Academy Press, Washington, D.C. (1988) and U.S.
Congressional Record, Washington, D.C. (July 31, 1990)]

This Bill has as its laudable goal the use of limited available Federal funds for research assistantships by the maximum possible number of U.S. citizens and declared immigrant aliens.

The prevalence of foreign and foreign-born engineers in the United States was identified by the NAE as an important issue a few years ago. It asked the Office of Scientific and Engineering Personnel of the National Research Council to form a committee to study its implications. I served as Chair of this committee. We started our deliberations with the very same objective of increasing U.S. citizen participation in graduate studies. We proceeded to examine the means by which this objective could be reached while protecting, to the maximum extent possible, the vitality of the U.S. academic research enterprise and the industrial base which it supports. Our studies clearly showed that we currently profit from and will continue to require for some years to come the services of foreign and foreign-born engineers. Foreign and foreign-born engineers are essential participants in industrial research, development and manufacturing, as well as in university research and instruction. Without their participation, the country would suffer serious constraints in essential activities that have immediate bearing on competitiveness in international markets and the economic well being of our citizens.

We concluded that the problem was not the prevalence of foreign and foreign-born engineers in our work places. Instead the issue was and remains the absence of adequate numbers of U.S.-born engineers. Our deliberations were largely focused on engineers with post-baccalaureate degrees, especially at the doctorate level. The supply deficiency was and remains the direct result of inadequate numbers of U.S.-born students in our graduate programs. A drastic improvement in this supply situation cannot be created rapidly but requires instead better trained and increasing numbers of American students at all educational levels who will ultimately choose mathematics, science, and engineering as preferred career options. In other words, the long-term solution will require concerted

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[1]Editor-in-Chief of Energy - The International Journal and Professor of Engineering Physics, Emeritus, University of California/San Diego, La Jolla, CA 92093-0310.

efforts to correct educational deficiencies beginning with the first grade and then extending throughout the years in primary school, high school and even the universities.

I believe the resources required to implement the provisions of H.R. 4595 would better serve the desired stated goal of increasing the number of U.S. citizens who choose such careers if they were directed at improving and enriching the K through 12 and undergraduate college instructional programs in mathematics and science. Deficiencies at higher educational levels are in large part the result of problems created by the lack of adequate instruction at lower grade levels. There is a very large pool of potential participants who are not now properly motivated to seek careers in mathematics, science or engineering, especially among women and members of minority groups.

Our Committee proposed some short-term remedial measures which would have the effect of attracting more U.S. students to pursue graduate training in fields of engineering for which the shortages of professionals appeared to be most acute during our deliberations. We suggested increasing the stipends of engineering graduate students above those in other disciplines in the same manner as the salaries of professors of engineering have been augmented above average academic salary levels for equivalent ranks. We also suggested the additional of new and attractive fellowships restricted to U.S. citizens. While there have been some positive responses to this last recommendation, the total funds available for stipends of all types have not grown adequately.

I am convinced that qualified U.S. citizens receive now preferred treatment for admission and training at U.S. universities, regardless of the source of funds used for the support of graduate students. Thus, it is unnecessary to make such preference issue a matter for new legislation. Admission priorities currently used by research universities are so heavily biased in favor of native applicants that only exceptionally qualified foreign applicants can pass existing barriers to their admission. I do not believe it would serve the national interest to diminish the training and immigration of exceptionally well-qualified students from foreign lands, the only ones among a huge pool of these applicants who achieve success in gaining admission as graduate students under currently existing operational procedures.

Special measures to track the disposition of federally-supported research assistantships are not needed. We found that a substantial majority (70% or more) of foreign students in engineering ultimately become permanent immigrants and then U.S. citizens. This fraction could be further increased by lifting permanent residency restrictions for U.S.-trained professionals to allow these people greater flexibility in employment choices. New restrictions on the use of Federal funds will thus serve little purpose other than to increase significantly the administrative burdens imposed on our institutions of higher learning.

It is appropriate to note that the recent economic decline, accompanied by the drastic projected build-down of the defense establishment, the extensive restructuring of industry, and reduced spending at our universities, has temporarily served to alleviate market stringencies in many disciplines. We should not be guided by current market conditions in formulating policy. It takes four to five years to produce a new baccalaureate

in engineering; and it takes five or more years in addition to produce a new doctorate. Our thinking about current student support should therefore be defined by the types of market conditions we anticipate ten years from now. Projected demographic trends, current student attitudes and plans about career choices, and impending increases in retirements from our work force combine to provide cause for concern about this future. As the result, it is appropriate to implement now the long-term remedial measures that are needed to achieve some measure of future U.S. self-sufficiency for highly trained mathematicians, scientists and engineers.

It is also appropriate to note that proficiency in mathematics, science and engineering is needed for well educated citizens who may not be practicing professionals and that discovery, innovation and successful commercialization of new inventions are proceeding even now when the opportunity horizon for professionals is clouded and highly-trained individuals have special motivation to spawn the growth technologies needed to assure the future well being and high standards of living that we all seek for our citizens. For this reason, curtailment of immigration by exceptionally talented individuals may not be in our best national interests even during periods of temporary oversupply.

Appended to my testimony are memoranda which I submit for the record from Chancellors Richard C. Atkinson of the University of California, San Diego and Chang-Lin Tien of the University of California, Berkeley. Their careful evaluations of H.R. 4595 include assessments of the administrative cost implications of enactment of this Bill, which Chancellor Atkinson estimates at $150,000 per year for his campus. Chancellor Tien makes the following statement, "Like most American universities, the University of California does not recruit foreign students. The one category that we do recruit vigorously is American minority applicants."

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OFFICE OF THE CHANCELLOR

LA JOLLA, CALIFORNIA 92093

April 23, 1992

PROFESSOR S. S. PENNER
Department of Applied Mechanics and Engineering Sciences

SUBJECT: American Math and Science Student Support Act

Dear Sol:

Thank you for providing me with a copy of HR 4595, the American Math and Science Student Support Act, which I have carefully reviewed. Congressman Henry has identified a serious national problem that needs to be addressed, but I have several concerns about the approach taken in this proposed legislation.

The bill seems to be based on the misapprehension that American universities give preference in some way to non-immigrant aliens. Our experience and that of other universities I am familiar with is exactly the opposite. This is borne out by a recent AAU/AGS study which showed that while US citizens constitute only about 40 percent of applicants to 142 doctoral programs in several science and engineering fields, they make up 60 percent of newly enrolled students, despite the fact that foreign applicants as a group are better prepared for graduate education than American applicants.

What this and other evidence suggest is that we as a nation need to improve substantially the preparation of our primary, secondary, and college students in mathematics and science so they will have the ability and interest to go on to graduate school and pursue careers in science and engineering. The large number of foreign science and engineering graduate students we have had in recent years is a sad reflection of this lack of interest and inadequate preparation; it is not the result of a lack of interest in and support for American students on the part of our graduate schools.

As I have indicated previously on a number of occasions, the federal government has an important role to play in encouraging qualified American undergraduates to go on to graduate school. In recent years, too many of our most able students have opted for professions that require less preparation and/or offer the possibility of substantially higher financial remuneration. One way to reverse this trend is to strengthen our national graduate fellowship programs. Much progress has been made over the past few years with the

establishment of the Graduate Assistance in Areas of National Need Fellowships, the National Science Foundation Graduate Traineeships, the Department of Defense Graduate Fellowships, and several programs to identify and recruit minorities and women to graduate study. Despite the addition of these new programs, the size of our federal fellowship programs pales by comparison with our efforts in this area twenty-five years ago. If we are to increase the number of Americans pursuing graduate education, we need to take positive steps to address the fundamental problem rather than impose restrictions that deal only with the symptoms.

My principal problem with the Henry Bill is that it would fail to encourage more U.S. citizens to become Ph.D. scientists and engineers. I am also concerned that it would impose a significant administrative burden on universities. This would come at a time when we are facing financial exigencies and the federal government is imposing limits on the administrative component of indirect costs. I estimate that the costs to UCSD would be on the order of $150,000 per year in faculty and staff time, expenditures for programming and computing operations, and general office expense.

Staff time would be required to review and obtain incomplete information for individual student records; to communicate with, encourage, and ensure that the approximately 500 UCSD faculty selecting RAs have made efforts to hire U.S. citizens and that no qualified U.S. citizens are available; to prepare, disseminate, explain, and collect statements of intent from individual foreign students; to program systems to extract the required data; and to prepare the several reports required by the bill. One of the required reports--expenditures of funds for the indirect benefits of alien versus domestic students--would be exceptionally difficult to provide as there is no generally accepted methodology for measuring such benefits.

The shortage of U.S.-born scientists and engineers, especially minorities and women, is indeed a serious national problem. I appreciate Congressman Henry's having called attention to this problem. I am confident that the higher education community is eager to work with him to find constructive solutions.

Sincerely,

Richard C. Atkinson

Richard C. Atkinson
Chancellor

UNIVERSITY OF CALIFORNIA, BERKELEY

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OFFICE OF THE CHANCELLOR — BERKELEY, CALIFORNIA 94720

April 22, 1992

Professor S. S. Penner
Center for Energy & Combustion Research
9500 Gilman Drive
University of California, San Diego
La Jolla, CA 92093-0310

Dear Professor Penner:

I am responding to your letter of April 10, 1992, regarding the Congressional Hearings on the American Math and Science Student Act (H.R. 4595).

The provisions of H.R. 4595, the American Math and Science Support Act, would have a negative effect upon the conduct of scientific and technological training and research in the university. While the bill's cumbersome and costly reporting requirements will place a damper on the financial support of foreign graduate students, it does nothing to achieve a most desirable positive goal, namely increasing the number of American students who apply to graduate schools in mathematics and science. This goal could be effected by improving scientific education, especially in elementary and secondary schools but also at the college level.

Like most American universities, the University of California does not recruit foreign students. (The one category that we do recruit vigorously is American minority applicants.) Consequently when an American and a foreign applicant have equal qualifications, the American applicant will invariably gain admission. In some scientific and technical fields, however, the number of American applicants is so modest that programs can only be maintained through the admission of foreign applicants.

The perception that foreign students receive a great deal of financial support in the form of research assistantships must be placed in perspective. Some sources, such as federally funded fellowships and the traineeships funded by the National Institutes of Health, are restricted to Americans. Seeming disparities between domestic and foreign students in amounts of research support can be largely accounted for by the fact that some research assistantships are concentrated in fields to which Americans are less likely to apply.

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On the positive side, foreign students add their perspectives to the environment of learning in this country, enriching it immeasurably for their American student colleagues. Even those who return home after completing their education here are a source of greater good-will and influence during their subsequent careers than we can ever achieve through foreign aid expenditures.

Many of our most talented graduate students in the sciences and engineering come to us from abroad, to the extent that foreign observers are frequently alarmed at what they consider to be a brain drain out of their countries into the United States. Since 57% of our foreign students remain in this country after receiving their graduate degrees, this phenomenon gives America a distinct advantage in world economic competition. Some of these become highly successful researchers, responsible for scientific and technological innovations; others found companies that provide jobs for thousands of American workers.

Sincerely,

Chang-Lin Tien
Chancellor

Mr. BOUCHER. Thank you very much, Dr. Penner.

Dr. Morris, we will be pleased to hear from you.

Dr. MORRIS. Thank you, Mr. Chairman, Mr. Packard, Mr. Henry—

Mr. BOUCHER. And, Dr. Morris, if you would use the microphone, please.

Dr. MORRIS. Oh. I'm sorry.

Thank you, Mr. Chairman, Mr. Packard, Mr. Henry, members of the committee.

Others who are testifying here are often to attack H.R. 4595 because of costs or some additional burdens that it places on a university. In my opinion, the burdens that they place on universities pale in comparison with the needs that this legislation is only a first step toward addressing, and I'd like to—and I'll probably make that clear when I—I'm not sure that everyone is fully aware of the problem and the extent of it. But I want to really, I want to focus today on some solutions that I think are going to go beyond H.R. 4595 and why.

I'll discuss the effects of past and current American university research practices on the African-American population because I disagree with Dr. Penner when he says that American university application procedures are biased in favor of American applicants, especially minority applicants. And I'll be willing to go into detail on that in the questions and answers.

I will point out that one of the—that there are some unintended consequences of the extensive domination of some of our most advanced sciences of international students on the Ph.D. level that we haven't talked about, but I will talk about them, because I believe that one of these unintended consequences is that we are moving in ways that we might make the world a little bit more unsafe in spite of the reduction in superpower conflicts.

And I'll conclude by suggesting remedies that go beyond H.R. 4595 because I think if we really are going to address this we are going to see that we are going to have to go beyond this.

Now, one of the things we should discuss first, because it's always raised whenever I point out the privileged position of international doctorate students, especially in the sciences, compared with the position of American minorities—the fundamental questions are why—is this a valid question and why is it? Well, there are numerous reasons. Just let me give you a few.

The first and more fundamental reason is that non-American citizens are really benefiting from the best graduate assistance disproportionately. In contrast, African-American—and in the previous question of Dr. Hancock that Dr. Henry—Mr. Henry was raising and the comparison with all American students, and it was bad there. But it is much worse in every single category of funding doctoral support for African-American students. Just a point which needs to be made.

So African-American—while non-American citizens are benefiting the most from this most desired assistance, and I'll tell you why, if we go into questions, it is more desired, than the kind of assistance that is being made through programs or through fellowships to minorities or especially to African-Americans.

A second reason—these research assistantships are primarily paid through by Federal taxpayer funds that we all pay for. All of us, including minorities. I have a chart up there, which I won't really show, that shows especially the—some of the status of African-Americans, and especially African-American males, in this in the country. And we pay our share of taxes and we certainly should be able to benefit as much as our guests from all of the benefits of American citizenship and all of the advantages.

Now, a third reason is that American research universities really have less incentive to either care or produce more minority students if they can find all the students they need from overseas. Now, I will point out that the lack of real public accountability, because in speaking throughout the country most Americans do not know what is happening. It might be quite familiar to this panel, and it might be familiar to those of us who are deeply involved in the system, but most Americans really don't believe that we use Federal funds to better support many of our guests than we do of our own, and especially our own who are the worse off economically. They do not know that, ladies and gentlemen. They really don't.

And the—and my point is that unless the incentives change, the financial incentives change, we are not going to get a change from American universities to lead them to search for minority Ph.D.'s the way they might search for, you know, a 240-pound forward who can jump like Michael Jordan.

But, you know, it's ironic that it's only in America is it necessary to make the argument that it's in our own national interest to develop all of our potential human capacities. And, if our human resources that have not benefited from development are disproportionately minority, it would seem that it would not take a great deal of intellect to understand that this should be a priority that we could all benefit from—a priority. The contributions which are likely to be increasing are stimulating our economy, people would be more likely to pay American taxes, and people would be more credible role models for future faculty and students to follow.

It seems inconceivable that we could not just as a basic understanding—in no other country would a person have to make that argument that we need to, you know, make sure that we take care of all of our students. And I'm speaking not just of American minority students. The financial aid differential really impacts on all American students, who should have equal access to this best kind of funding.

The irony is that, while federally—international students are benefiting from federally supported research funds, we find the minorities are getting separate fellowships or programs, which are not the same things. Give us the money. Don't let us have to borrow to go and pay for our education, while 70 percent of international students get their doctoral education debt free.

Let me talk a little bit about the problem. I'd like to have as an attendant to this a paper, which is a speech which I gave at the Council of Graduate Schools,[1] because it goes into great detail and

[1]Paper included in appendix, p. 163.

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tries to point out that most of the figures that Mr. Hancock really didn't accept or had problems with come from the National Research Council doctoral study of the National Academy of Sciences. So—but it's important to really—to show what we know.

Now, in that I simply point out that African-Americans are 13 percent of the U.S. population, but we received less than 3 percent of the doctorates in 1990, and while non-American citizens received 28 percent of all the doctorates that year. African-American males—I won't carry you through all of this, but just certain kinds of things will highlight the point—African-American males are 6 percent of the U.S. population, 47 percent of the U.S. prison population, 5 percent of the top corporate positions—not CEOs, but vice presidents and above—but only 3 percent of those would access the postsecondary education, and less than 1 percent of those received doctorates from American universities in 1990. In contrast, non-American citizen males were 21 percent of all the males—of all the doctorates. Clearly, if equity doesn't cry out here for a priority, you know, certainly and hopefully national interest will.

I'll point out very quickly that the better university support—and research assistantships are the best—the best. Non-American citizens got better support or more of these research assistantships over African-Americans in every single field. Not just one, every single field. You know, the argument implies that this is just a problem in the sciences. But every single field—the humanities, the social sciences. I contend that this is not only grossly unfair, it's against our national interest.

I point out that we have critical fields of the future where American universities, not only in 1990, but in other years have not produced one single African-American Ph.D. We have 26—we have 26 million people, folks. Not one single in critical fields: mathematical fields, geology, geophysics and seismology, chemical engineering, industrial engineering, electrical mechanics, material science, nuclear engineering—it goes on and on and on. This cannot continue.

I also point out another factor. That everyone claims that there is a real inadequate number of American Ph.D.'s. The number of African-Americans who receive Ph.D.'s from American universities who are able to get positions in academia dropped from 68 percent of a larger number in 1975 down to 57 percent in 1990. Ironically, we see international students rise from 52 percent in '75 to 58 percent in '90 of a much, much, geometrically much greater number. So how can we say that we have, you know, a shortage or we can't find a pipeline when we—you know, some of those who qualify can't get positions.

Let me go on to some of the other information. You will see this documented in my paper. What I really want to talk about today are some of the unintended consequences of what's happening. The fact that American universities seem to be indiscriminately training international scientists from countries where scientific knowledge could be put to future military purposes. In my paper I point out that we, we know from the data that the majority of our international students come from a number, a small number of countries, particularly India, China, South Korea, Taiwan. I want to focus on India and China a little bit.

We seem to be oblivious to the fact that we could be working against our long-term interests, especially in the area of nuclear proliferation. I'd like to urge everyone to read Kathleen Bailey's book *The Doomsday Weapons In the Hands of Many,* University of Illinois Press, 1990. She points out that with the scientific field training India—the United States was not able to prevent India from acquiring nuclear arms. That China, for whom many of our students are here, have subsequently been helping Pakistan develop nuclear weapons. China has subsequently helped Libya in attaining chemical weapons. China has worked with Brazil to help develop advanced missiles for export to the Third World. They have helped Iran in the production of artillery rockets. And they have recently, in 1990, signed a 10-year agreement with Iran for "scientific cooperation for the transfer of military technology."

Not only are we hurting ourselves for not having more, but I raise the question, do we really know the consequences of, for instance, focusing our Chinese training in the sciences when after Tiananmen Square we would hope that we may need more—American universities may have more of an offering in the fields of the humanities and the social sciences.

But the saddest part of this discussion is the way American universities seem to accept this as the natural order of things, these tremendously low rates of African-American Ph.D.'s. In my State of Maryland, where—you know, I'll bring it home. No sense in—don't want to talk about any other State. Let's talk about my home State, where African-Americans are 25 percent of the population. Our major doctoral institutions do not question doctoral rates which produce 25 to 27 percent international students, for the two major ones, and 6 and less than 1 percent of African-Americans, where we are paying considerable amounts of the taxes. So I'm saying that unless this is changed it's just not going to happen.

Now, everyone says, Well, why? You ask why is this happening? I think we need to really look at our own tradition and our own culture. We make an assumption that American universities automatically, automatically care equally about all American populations, or that American universities aren't like the rest of the society and that the trends and the biases that have led over time to inappropriate attitudes, to bigotry and bias sometimes are somehow free of university/faculty considerations.

I'd like to—I'd just really quote from Professor Hacker's new book, which I think is really brilliant. He points out that it isn't the competitiveness that we fail, that America has always been the most competitive of all societies. It always poses its citizens one against another with the warning that one must make it on its own. Hence, the stress of moving past and the fear of falling behind. He points out that no other nation rates as winners and losers. But then listen to what he then goes on to say.

"The significance of American racism lies in the way it consigns certain human beings to the margin of society, if not painful lives and early deaths. In the United States racism takes its highest toll on blacks. No white person can claim to have suffered in the ways because of the ideas that are held about them by black citizens."

But the final paragraph: "Ideas about inequality and inferiority are not simply figments of people's minds. Such sentiments have

an impact on how institutions operate, and opinions tend to be self-fulfilling. If members of a minority race are believed to deficient in character or capacities, the larger society—

Mr. BOUCHER. Dr. Morris, if I could interrupt you for a moment? We did ask that the statements be held to 5 minutes and you are going on 15 now.

Dr. MORRIS. Oh, I'm sorry.

Mr. BOUCHER. If you could conclude in just about 2 minutes, we would appreciate it.

Dr. MORRIS. In two minutes. That we need—in terms of additional legislation, we need funds to guarantee support for all American graduate students to a much greater level than we're having now. That we need to really to a provision that when—for Federal, they use the Federal funds and international students are supported, then there should also be an equal obligation of the American universities to support American minority students or underrepresented Americans. That we should recognize that if American research universities do not believe that blacks or others have the capacity to get Ph.D.'s that our Historically Black Institutions and institutions that are sensitive to Hispanics, if given the funds and can create the Ph.D. programs, that will produce for the betterment. And then, finally, we need an American incentive computation. That whenever, in all competitions of Federal funds, if there was an incentive that would say that when the institution or the department either has a track record or has produced minority graduates either equal or proportional to international students, then they would get a bonus. And somehow, or a penalty would go into consideration for those that don't. Then I assure you we would begin to see some changes.

[The prepared statement of Dr. Morris follows:]

TESTIMONY IN SUPPORT OF H R 4595

BY

DEAN FRANK L. MORRIS

DEAN OF GRADUATE STUDIES AND RESEARCH

MORGAN STATE UNIVERSITY

AND

PRESIDENT

COUNCIL OF HISTORICALLY BLACK GRADUATE SCHOOLS

APRIL 29,1992

DEAN FRANK L. MORRIS SR

Mr. Chairperson and members of the Science, Space and Technology Committee, it is my pleasure to testify in favor of the American Math and Science Student Support Act recently introduced by Congressman Henry (H.R. 4595). Others who testify here are likely to attack the proposed legislation because it places additional requirements that lead to greater research university accountability on this issue. In my opinion these concerns pale in comparison to the implications of this legislation that I will briefly discuss below.

I will discuss the effects of past and current American research university practices on our African American population. Many of the current practices have placed all American graduate students at disadvantages vis a vis international students. Many of the current practices will lead to the world becoming a much less safe place in the future. American research universities abuse the concept of merit in responding to the needs of our African American population. I will conclude by suggesting other remedies that go beyond H.R. 4595 that I predict will be necessary before major American research universities will have the proper financial incentive to do the right thing for American minority students.

One matter that should be discussed first is why should comparisons be made between American doctoral recipients and international doctoral recipients. The reasons are numerous. The most fundamental reason is that non American citizens benefit **most** from the **best** graduate assistance while African American doctoral recipients benefit from this most advantageous financing the **least.** A second reason is that this best university support in the form of research assistantships are primarily financed through federal research grants that are funded from taxes taken from all of our people including American minorities. A third reason is that university research universities have less incentive to either care or to help produce more American minority scholars if they find all the students they need and more from overseas. I will point out that the lack of public accountability and financial incentives or penalties does not create adequate motivation for American research universities to produce more American minority Ph.D.'s. Only in America is it necessary to make the argument that it is in our national interest to develop our under utilized human resources (who disproportionally happen to be American minorities). Our American Ph.D.'s. are likely to stimulate our economy, more

likely to pay American taxes, and are more likely to be more creditable role models for future faculty and students to follow. The converse is also true. If the current trends and patterns of American research university benign neglect of African American doctoral students in the sciences is allowed to continue then we are mortgaging our future because it is already clear that future quality of life as well as economic development requires greater utilization of knowledge based, communication and information skills.

The Problem

For a through discussion of the problem I refer the reader to my paper which was my speech to the plenary session of the Council of Graduate schools last December. In summary it made the following points:

African American citizens constitute more than 13% of the US population but received less than 3% of the doctorates from United States universities in 1990 while non American citizens received 28% of all doctorates from American universities that year.

African American males constitute 6% of the US population, 47% of the US prison population, 5% of top corporate positions in the private sector, but constitute less than 3% of those with access to post secondary education and less than 1% of those who received doctorates from American universities in 1990 in comparison with non American citizen males who received 21% of all doctorates from American universities in 1990.

African American males are the only underrepresented American minority group who has suffered a loss of more than 50% in the receipt of Ph.D.'s from American universities since 1975-77 while the number of Ph.D.'s going to all other underrepresented American minority groups has increased considerably and the number of Ph.D.'s from American universities going to non American citizens has increased more than 60% during that time.

The 1990 Doctoral Project of the National Research Council of the National Academy of Sciences documented that American research universities provided better support to the international students who received doctorates compared to the funding they provided to African Americans who received doctorates. This better American University support of non American citizens over African Americans held for **every** doctoral and professional field including the humanities, education and the social sciences.

The result of such funding was that the more numerous international students who received better funding resulted with 70 % of the almost 9500 non American citizens who received doctorates not incurring any debt to complete their doctorates while almost 70% of both the much smaller number of African American (820) and Hispanic doctoral recipients incurred debt with 25% of the Black recipients and 33% of the Hispanic recipients incurring doctoral educational debt of more than 10,000.

Direct federal grant funding for doctoral support has declined in favor of more loan funding (for American citizens) with the result that almost 70% of all funding for graduate education is in the form of federally subsidized research assistants that research university faculty are much more likely to give to international students in comparison with American minorities.

American universities produced non American citizen doctorates in fields where they did not produce a single African American citizen doctorate in 1990 and in some cases for more than one year. These fields include applied math, algebra, number theory, topography, operations research, general math, astronomy, acoustics, atomic and molecular, elementary particles and nuclear physics, optics, plasma, analytical chemistry, geology, geophysics and seismology, oceanography, civil engineering, engineering mechanics, industrial engineering, materials science, nuclear engineering, petroleum engineering, systems engineering,biophysics, ecology, molecular biology, microbiology and bacteriology, neuroscience and numerous others that are critical for African Americans to participate in for future economic development and for future faculty positions. In some of these fields American universities produced hundreds of international doctorates without a single African American doctorate. No African American received a doctorate in agricultural and food chemistry in spite of the fact that probably the greatest scientist who ever lived in this field was a poor African American.

American universities contend that they cannot find African American faculty, only 57% of the African Americans who received doctorates from American universities in 1990 were hired by American Universities,in stark contrast 68% of the African Americans who received doctorates from American universities in 1975 were hired by American universities. The percentage of the much larger number of international doctorate recipients hired by American universities has increased from 52% in 1975 to 58% in 1990 for a much larger number of recipients. Thus American universities hire a higher percentage of a much larger number of non American citizen doctoral recipients from American universities than African American doctoral recipients from American universities.

DEAN FRANK L. MORRIS SR.

The organizations which represent American universities supported changes in the 1990 immigration act which made it easier for international students and faculty to take positions in American universities. This is consistent with the historical pattern of American research university faculties preferring international faculty and students over American minorities, especially African American males

Whereas it should be clear to everyone that the above situation will not change unless major funding and funding incentives for American universities change.

Unanticipated Consequences

American universities are indiscriminately training international scientists from countries where the scientific knowledge they learn here could be utilized for military purposes which could result in further world instability. This fact was not apparent to me when I started to examine this issue. American universities point with pride to the fact that they are giving thousands of students from China, India and South Korea doctorates in our most advanced scientific fields. Yet these universities seem obvious to the fact that they could be working against the long term interest of our nation and the world by providing US taxpayer subsidized training in fields that have military conversion prospects and possibilities. Kathleen Bailey has pointed out that the US was not able to prevent India from acquiring nuclear arms; China subsequently has been helping Pakistan develop nuclear weapons; and China has subsequently helped Libya in obtaining chemical weapons; worked with Brazil to develop advanced missile for export to the third world; helped Iran in the production of artillery rockets, and signed a 10 year agreement with Iran for "scientific cooperation and the transfer of military technology.[1]

Clearly we are training some countries in the sciences where the world may be better served if we trained them in the social sciences or humanities. After the events of the past few years is it any wonder that China sends her students here disproportionally for training in the sciences rather than in the humanities or social sciences?

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[1]Kathleen C. Bailey. Doomsday Weapons in the Hands of Many: the Arms Control Challenge of the 1990s. University of Illinois Press, Urbana and Chicago 1991, pp.25,44, 63,115..

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One of the saddest aspects of this discussion is the way American research universities seem to accept as the natural order of things the low rates of African American Ph.D.'s. In my state of Maryland, where African Americans are 25% of the population, the major national newspapers in their editorials and the major state educational institutions do not question international students receiving 26 and 27% of their doctoral degrees from Johns Hopkins and the University of Maryland at College Park while African Americans receive 6% of the doctorates from College Park and less than 1% from Johns Hopkins. Yet Johns Hopkins is probably the leading University in the receipt of federal research funding and the state of Maryland gave them more than 9 million dollars in unrestricted funds in 1990. I believe that you will find similar patterns in your states

Andrew Hacker in a brilliant new book, helps to explain how unfairness to our citizens of color is a part of American culture.

> America has always been the most competitive of all societies. It poses its citizens against one another, with the warning that they must make it on their own. Hence the stress on moving past others,driven by a fear of falling behind. No other nation rates its residents as winners or losers.
>
> ...The significance of (American) racism lies in the way it consigns certain human beings to the margins of society, if not, painful lives and early deaths. In the United States, racism takes its highest toll on blacks. No white person can claim to have suffered in such ways because of the ideas that may be held about them by black citizens.
>
> Ideas about equality and inferiority are not simply figments of peoples minds. Such sentiments have an impact upon how institutions operate, and opinions tend to be self fulfilling. If members of a minority race are believed to be deficient in character or capacities, then larger society will consign them to subordinate positions.[2]

The tragedy is that American research university departments believe that somehow international students are better than African American students in the sciences. As the Educational Testing Service has noted, often university departments will misuse standardized tests with the result

[2] Andrew Hacker Two Nations: Black and White, Separate, Hostile, Unequal Scribner, New York, 1992 p.29

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that African Americans are excluded. They will control graduate educational access to doctoral support in scientific fields through standardized tests which most measure the mastery of advanced American high school mathematics and English. While these departments will use these tests to disqualify many African American students on the quantitative test, they will ignore and even provide nurturing for international students who may have test apparent deficiencies in English.[3] This is consistent with the currently high esteem some non American citizens are held and the classical traditional American way African American people and students are perceived by American research universities. We assume that these universities are always acting in the interest of all Americans including African Americans. The evidence is that particular assumption is flawed in the case of African Americans. I am asking you to remember that as you consider this legislation.

Proposed Legislation

I support H. R. 4595. This bill is a step in the right direction to address the problem. Yet there is no doubt in my mind that Universities will make a pro forma certification that there are no American citizens available in order to reinforce their preferences and in some cases biases in favor of some international students and against some African Americans. we should be sure that all Americans who are qualified and want to pursue doctorates have adequate funding before funding non American citizens.I am therefore requesting that you and other committees of the Congress enact the following legislation.

1. Support legislation that will guarantee research assistant type support for all qualified American doctoral students. We should not require American students,especially Americans minority students from families with less wealth and income to have to go into debt to finance their education while we subsidize our non citizen guests so that the overwhelming majority get their doctorates debt free.

2. Whenever American universities use federal (or state) funds for graduate student research support, and whenever that support covers more than one student, then for every international student that American faculty members chose to support with these federal (or state) funds, they must also support an underrepresented American minority student.

[3] Anthony DePalma As Black Ph.D.s Taper Off Aid For Foreigners is Assailed New York Times Vol 141 No 48,943 April 21 1992 pp 1 A 18

3.Currently it is clear that major American research universities are not going to provide research opportunities for American minority students comparable to the research opportunities that they currently provide for international students. Throughout American history these major heavily federally subsidized American research universities have **never** provided opportunities for American minorities of color comparable to the opportunities provided for African American scholars by the historically Black colleges and Universities. These under funded HBCUs have been given neither the resources nor the state authority to provide comprehensive graduate research comparable to what has been offered by our heavily federally subsidized research universities. Now is the time to address this issue by providing major research commitments to HBCUs and HACU institutions who have successfully demonstrated their ability to graduate quality undergraduates, especially quality undergraduates in the sciences. It is likely that only these institutions will provide the quality research environment that will develop our minority talent that is currently being lost to this nation.

4. There should be an **American incentive computation** in every federal (or state) research contract where doctoral students are supported. Universities where the underrepresented minority percentage of Ph.D. graduates in the state equals the proportion of underrepresented minorities in their state populations will receive a 10 point bonus in every federal or state competitive research contract. Conversely, universities which have traditionally used federal funds to support more than three times as many non American citizens as underrepresented American minorities in research, will have their final score deducted by 10 points. This procedure will finally create the financial incentives necessary for research universities to develop and recruit underrepresented American Ph.D.'s in a manner more comparable to the way they are willing to recruit underrepresented minorities from all kinds of limited academic backgrounds for revenue generating athletics.

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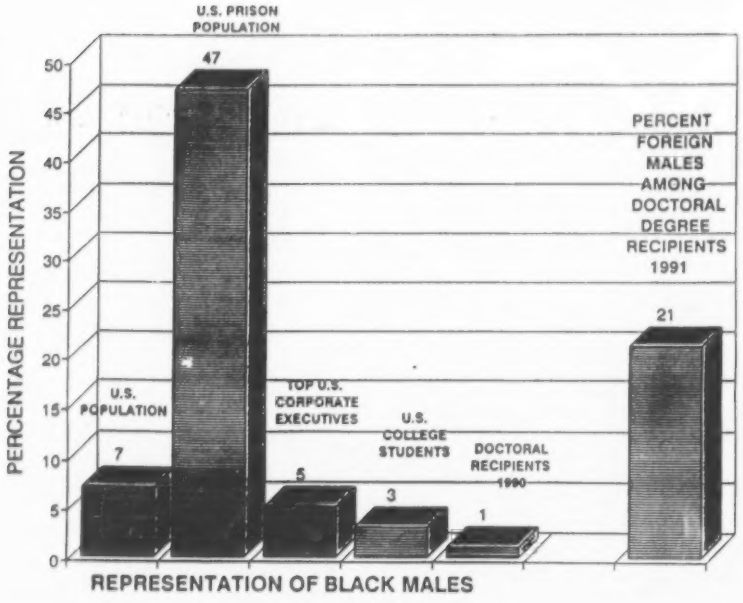
U.S. PRISON POPULATION
47
PERCENT FOREIGN MALES AMONG DOCTORAL DEGREE RECIPIENTS 1991
21
U.S. POPULATION
7
TOP U.S. CORPORATE EXECUTIVES
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DOCTORAL RECIPIENTS 1990
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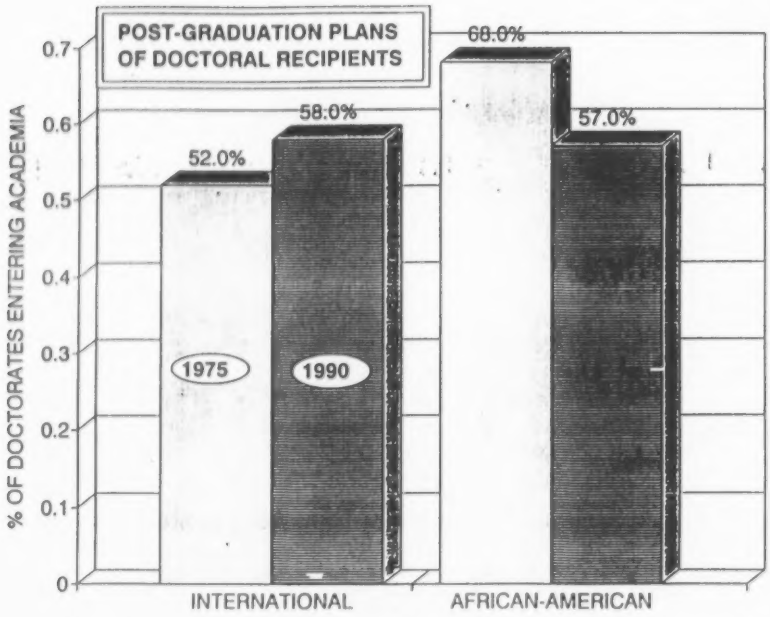
REPRESENTATION OF BLACK MALES


POST-GRADUATION PLANS
OF DOCTORAL RECIPIENTS
% OF DOCTORATES ENTERING ACADEMIA
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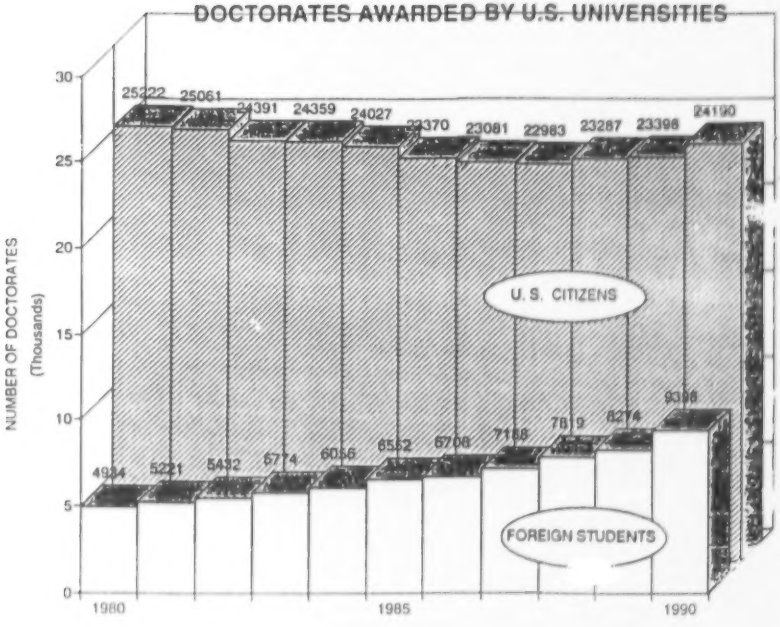
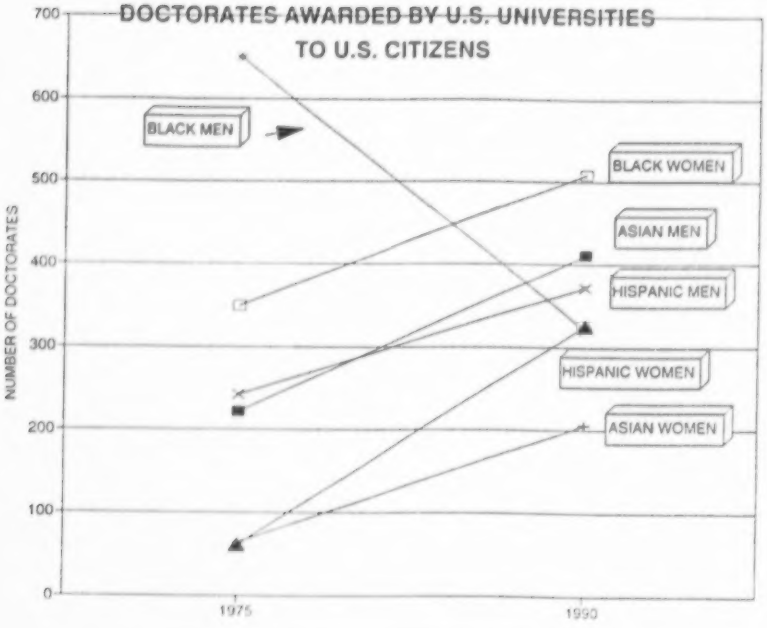
1975
1990
INTERNATIONAL
AFRICAN-AMERICAN

TABLE 1



Thurgood, D.H., and J.M. Weinman. 1991. *Summary Report 1990: Doctorate Recipients from United States Universities.* Washington, D.C. National Advisory Press. Table prepared by Office of Institutional Planning and Evaluation, Morgan State University.

FIGURE 1



Thurgood, D.H., and J.M. Weinman. 1991. *Summary Report 1990: Doctorate Recipients from United States Universities*. Washington, D.C. National Advisory Press. Table prepared by Office of Institutional Planning and Evaluation, Morgan State University.

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Frank L. Morris Sr., Ph.D

Brief Biography

Frank Morris is currently the Dean of Graduate Studies and Research and Professor of Political Science at Morgan State University in Baltimore. His prior academic positions were as Associate Dean of the Graduate School of Public Affairs at the University of Maryland at College Park, Visiting Professor in the O'Connor Chair at Colgate University, Associate Professor of Political Science and Urban Affairs at Northwestern University in Evanston Ill., and as a MIT teaching assistant. His non academic experience includes Executive Director of the Congressional Black Caucus Foundation (83-85), service as a (now retired) senior foreign service officer for the U.S. Agency for International Development in the State Department, Chief of Planning and Policy Analysis for the Federal Community Services Administration, Special Assistant to the Director of the National Institute for Education, and other service in HUD and the New York State Mental Health Research Unit.

In his UCC church service he has been chairperson of his church trustee board (Lincoln Temple UCC), served as Moderator of the Potomac Association, and currently is a Corporate Board Member of the Board of Homeland Ministries.

He received his B.A. with High Honors from Colgate, a Masters in Public Administration from Syracuse, and a Ph.D in Political Science from MIT.

His honors include three awards from NAACP chapters, the Superior Honor Award from the Department of State, and a selection in 1975 as a father of the year by the Chicago Defender newspaper.

He currently is president of the Council of Historically Black Graduate Schools, he is on the Minority Committee of the Council of Graduate Schools, and on the Executive Committee of the Northeast Council of Graduate Schools.

Dean Frank L. Morris Sr. Ph.D

Mr. BOUCHER. Thank you very much.

Dr. MORRIS. Thank you.

Mr. BOUCHER. Dr. LaPidus, we'll be pleased to hear from you.

Dr. LAPIDUS. Thank you, Mr. Boucher, Mr. Henry, and Mr. Packard. I'm glad to be here this afternoon.

Being the last speaker on the panel, I have heard many things that I wanted to say said one way or another by many of the other speakers, and also by many of the people on the panel, so I won't repeat them in my testimony. They are in my written testimony.

Let me concentrate on just a few things. First of all, I am not convinced that this bill will have the desired effect of increasing the number of American students going into science, engineering or mathematics. I also think there is a likelihood that the bill could impede progress in American academic research largely by making it more difficult, albeit not impossible—but more difficult—for American universities to attract students from other countries. And finally, I think the paperwork burden implied by this bill, although I can't give you dollar figures, certainly would have the effect of driving up the administrative cost of research, and in addition to that, it would divert faculty members from research and teaching responsibilities to filling out more paper, and I think that's not a desirable consequence.

Given that, let me concentrate on three brief items. The first, since so much in the bill has to do with the way students are supported, is just a brief commentary on the support of graduate students. By and large, graduate students choose departments in much the same way that departments choose graduate students. And that is on both sides there is some attempt to assess the quality of either the students or the departments. And most particularly, in doctoral programs in the fields we're talking about now, there is an attempt to get a matchup, for a student's specific research interests within a field to match with a faculty member's within a field at a particular university.

In research universities the majority of students, full-time students in these fields—math, science, engineering—are supported either by teaching assistantships, research assistantships, fellowships or traineeships. That mix will vary from year to year, from institution to institution, even from program to program within institutions, depending on the availability of certain kinds of dollars, the availability of research grants obtained by the faculty, the size of classes and a need for teaching assistants and so on.

It will also vary depending on the progress toward a degree being made by the student. In my experience, U.S. citizens and foreign students with equivalent qualifications receive equivalent kinds of support throughout their graduate study, some mix of this support.

The second point has to do with foreign students in American universities without consideration of Americans. A hundred years ago, the most talented American students in science and mathematics were going to Europe for advanced study because that's where the best institutions were. That's reversed today. The reason that people are coming from all over the world to study in our institutions is because, particularly in these fields, American universities are preeminent in the world.

It happens that much of this migration has occurred, at least during the last 15 years, during a time when there seems to have been a loss of interest among American students in pursuing graduate careers in these fields. I think without the presence of foreign student there also would have been a decline in American research productivity during this time.

I don't have to document the accomplishments of foreign students either in American graduate programs or in their teaching and research roles in American universities or in science and industry. That has been referred by other panelists here and it appears in their testimony. By and large, though, I think that what we have seen in this country is the appearance of foreign students who are very well prepared for advanced work in these fields, who have come here and done good work and allowed us to proceed with an American research agenda, and from that perspective I think it's a good investment of Federal funds.

Finally, the last point that I would like to make. There has been much talk here today about the key issue. And I agree that the key issue is how to get more American students interested in science and research, and we have also discussed the fact that there is fairly general agreement that we have real problems in K through 12 math and science education and all the way up the line, fewer Americans majoring in these fields at the undergraduate level and so on.

I think it's important to note that there are programs and there have been programs designed specifically to affect those things. Some have been discussed by other panelists, the NSF programs. Not just to provide early opportunities for students to engage in laboratory work and research, not just early identification programs, but attempts to improve math and science education, K through 12 and at the undergraduate level, are very important but long-term effects.

There is a host of programs, almost all of them, I might add, specifically devoted to minorities, dealing with recruitment, retention, early identification, laboratory experiences, better advising, better mentoring, so on and so forth. The question is do any of these programs work? And I think there is evidence that they are working and that some of them are beginning to work very well.

For example, 1991 is the fourth consecutive year in which the number of American Ph.D.'s has increased. There was a long period of time, from about '75 to '86, where things were fairly stable, either declining or fairly stable. But it's moving up.

According to figures that we've obtained in our enrollment survey, since 1986 there have been really dramatic increases in the enrollment of minority students, particularly in the science and engineering fields, of the level of 30 percent. But the question is, if we have these enrollments, what does that mean in terms of degrees? Generally speaking, the time from enrollment in graduate school to Ph.D. can be anywhere from 5 to 8 years in these fields.

We have some very recent data, 1991 data, from the National Research Council, that's very promising. It shows, for example, that there has been, again, an increase in the number of American Ph.D.'s this year, but that there have been very significant increases in the number of minority Ph.D.'s in 1991. For example,

there has been a 22 percent increase in Asian Ph.D.'s, a 26 percent increase in black Ph.D.'s, a smaller increase, a 3 percent increase in Hispanics, an overall increase of about 2 percent in all Americans but again in the same direction.

What is most striking in these data to me has to do with the Ph.D.'s earned by black U.S. citizens in 1991. In 1990, there were 828 degrees—Ph.D.'s earned by black U.S. citizens. A number that is far too small and that we have to increase. That figure increased to 933. That is, 105 more Ph.D.s, between 1990 and 1991.

What is most significant in terms of this hearing in these figures is that 74 of those 105 new black Ph.D.'s in 1991 were in the fields of science and engineering. Now that leads me to believe that all of these programs, programs like, for example, Mr. Henry, the Talent Identification Program that is run by Duke University, which reaches out to students in the seventh grade and nurtures them throughout to get them into the right universities that can provide programs that suit their talents. Those programs are working. They take time to work.

I think that the continuation of strong and stable support for programs of that type coupled with increases in fellowship and traineeship support so that all qualified American students can get reasonable support while going through graduate school is the best way to ensure that more Americans go on to do doctoral work in these fields.

Thank you.

[The prepared statement of Dr. LaPidus follows:]

TESTIMONY

of

Jules B. LaPidus
President
Council of Graduate Schools

before the

United States House of Representatives
Committee on Science, Space and Technology
Subcommittee on Science

April 29, 1992

On behalf of:

Council of Graduate Schools

Association of American Universities

Testimony of Dr. Jules B. LaPidus, President
Council of Graduate Schools

Before the Subcommittee on Science
Committee on Science, Space and Technology
United States House of Representatives

April 29, 1992

Mr. Boucher and members of the Subcommittee on Science, my name is Jules B. LaPidus. I am President of the Council of Graduate Schools, an organization of 400 universities in the United States and Canada that award approximately 95% of the doctoral degrees and 70% of the master's degrees granted in the United States. I appreciate the opportunity to speak to you today.

I believe that H.R. 4595 would not have its desired effect of increasing the number of U.S. citizens doing graduate work in mathematics, science, and engineering. Further, H.R. 4595 would impede academic research in these fields by making it more difficult for American universities to utilize the best talent available to them. The reporting requirements in the bill have the potential of causing a huge increase in paperwork, thus increasing the administrative costs of research as well as diverting the faculty from their research and teaching responsibilities. These factors lead me to be opposed to the bill, and my concerns are centered in three areas.

First, the bill does not take into account the realities of graduate study in these fields, particularly the way students select programs, the way students and faculty decide to work together, and the way students receive support. Second, the bill would limit this country's ability to make the best use of all available resources in maintaining the quality of our research activities. Third, there are better and more direct ways to increase the number of U.S. citizens doing graduate work in these fields. Let me elaborate on these points.

1. Graduate programs in American universities, particularly those in mathematics, the sciences, and engineering, are preeminent in the world. Because of that status, they have attracted the best and brightest students from other countries to come to the United States for graduate study and research in these fields. Much of this research is supported by federal funds provided to universities through competitive grant and contract programs operated by agencies of this government. These programs are supported by the federal government to allow universities to pursue research judged to be in the national interest. Most of these research projects involve individuals or groups of people--graduate students, postdoctoral research associates, technicians--working under

the direction of a faculty member who serves as principal investigator and research supervisor.

In selecting students to work on these projects, faculty members operate under several constraints and imperatives. They must find graduate students with the appropriate background and training who not only have elected to study in the program in question, but have decided to specialize in the particular part of that field that is a research specialty of the faculty member in question. These students may then become advisees of the faculty member who undertakes to help find research support for them. For example, the professor of chemistry whose special interest involves the synthesis of certain kinds of organic molecules forms a research group of graduate students who have applied to study chemistry and whose interests coincide with those of the professor. Some of those students will be supported as teaching assistants, some as fellows or trainees. Those chosen as research assistants on grants or contracts represent a combination of background and interest that make them best suited for the particular research project at hand.

In both the selection of students and the provision of support, merit is a primary consideration. The objective is to successfully complete the research project and, while doing so, to train the graduate student so that he or she is successful in completing the graduate program. The federal government reaps two benefits from this process: the results of the research and the trained scholar.

The availability of financial support is an important factor when a prospective student chooses a graduate school. Specific institutions will have different amounts and different kinds of support available, depending on their need for teaching assistants, the amount of research grant dollars brought in by their faculty, and the number of fellowships and traineeships they may have. Appointments are usually made for one year, and their continuation depends on the availability of funds and the performance of the student. Many full-time graduate students in the fields under discussion receive support from a variety of sources while in graduate school. This is usually some combination of research assistantships, teaching assistantships, fellowships and/or traineeships, and possibly personal funds, either from work, savings, or loans. The mix depends on a number of factors including the faculty's evaluation of the ability of the student, the student's field of study, the year-to-year availability of any of these sources of funds, and the student's specific research interest within the several fields of study. In addition, research and teaching assistantships, as well as fellowships and traineeships are usually limited to full-time students. Foreign students are ineligible for most fellowships and traineeships, and are also ineligible for federally guaranteed loans and other forms of federal financial aid, except for some funds provided by the Fulbright Program. They cannot work because of U.S. visa restrictions, and they must be full-time students. Since there is some reluctance to appoint students whose native language is not English to

teaching assistantships, many foreign students are supported primarily as research assistants.

In the fields being discussed here, the majority of full-time students receive either assistantships, fellowships, or traineeships. This is particularly the case at major research universities where foreign graduate students are concentrated. In my experience, U.S. citizens and permanent residents with qualifications equivalent to foreign nationals are receiving similar kinds of support during the course of their graduate studies.

2. Much of the basic research that undergirds our national scientific and technological agenda is done by graduate students in connection with their doctoral programs. As a matter of national interest, we have to maintain a strong and vigorous academic research establishment. Prior to the development of American research universities, Americans who wished to pursue advanced study in science and mathematics went abroad to do so. Today, because of the excellence of American universities, the reverse is taking place. What this has meant in the United States is that we have been able to select the best qualified students in the world to participate in our research activities. This has been of great benefit to this country as well as to the continuing development of knowledge in these fields.

During the period from 1976-1986, an increasing number of graduate students in the fields of mathematics, science, and engineering have not been U.S. citizens, but rather temporary residents. During approximately the same time period, American student interest in advanced study in these areas declined. If it had not been for the availability of foreign students, American research productivity in these important fields also would have declined, but instead, it flourished. Furthermore, some foreign students sought permanent resident status and remained to teach and do research in our universities and to participate in industrial research and development. Their many contributions to American research and development are well documented. Those who did return to their home countries were likely to seek cooperative research opportunities with American colleagues and to help develop productive international research networks and projects. All in all, our experience with foreign graduate students has been a very good one. They have come to this country prepared to do advanced study and research that has furthered a research agenda judged to be in the best interest of the United States. The expenditure of federal funds to support them on research grants has been a wise and prudent investment.

3. We have seen a declining involvement of American citizens in graduate work in mathematics, science, and engineering. For the most part, this decline has been attributed to poor preparation in mathematics and science, particularly in the K-12 grades. There has been a series of reports showing American students to be near the bottom, in comparison with most developed countries, in mathematics and science knowledge. A recent editorial in *The Washington Post* (4/18/92) states, "The results of the 1990 federal survey (of student achievement in science) of nearly 20,000 students

bear striking similarities to the 1990 survey of student achievement in mathematics: students muddle along on the simplest tasks, but most cannot perform at the higher levels required for more advanced work--and for the workplace. Fewer than half the nation's high school seniors could interpret data in tables or graphs or design a science experiment."

In addition, decreasing numbers of American students major in mathematics or science at the undergraduate level. Although many take elementary courses in these subjects to satisfy general education requirements, fewer and fewer take the advanced undergraduate courses that form so much of the appropriate background for graduate work.

Finally, for the past 15-20 years, countless American television programs and movies have portrayed young people with academic interests, but particularly those with interests in science or mathematics as "nerds." A recent *Washington Post* series on Bethesda-Chevy Chase High School portrays many students and some teachers as being most interested in being "average" since excellence requires too much hard work on everybody's part. Those students who do excel academically are often viewed as being "different" and somewhat undesirable.

All of these factors have combined to decrease the number of American students prepared for and interested in graduate work in mathematics and the sciences.

Limiting the number of foreign students being supported on research grants will not increase the number of American students pursuing advanced study in mathematics, science, and engineering. Indeed, a recent study by the AAU/AGS Project for Research on Doctoral Education indicates that even attempts to give preference in the admission process will not be particularly effective. The study, titled "Major Research Universities Endeavoring to Increase the Number of U.S. Citizens Enrolled in Ph.D. Programs in Science and Engineering,"[1] evaluates 142 Ph.D. programs in the fields of biochemistry, economics, mathematics, and mechanical engineering, and shows that while U.S. citizens constituted 41% of fall 1989 applicants, they represented 53% of admitted applicants, and 59% of enrolled applicants.

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[1]Association of American Universities/Association of Graduate Schools (AAU/AGS) Project for Research on Doctoral Education. "Major Research Universities Endeavoring to Increase the Number of U.S. Citizens Enrolled in Ph.D. Programs in Science and Engineering," in *Research Bulletin 91-01*, University of Rochester, September 1991.

As pointed out in the report, preferential efforts to admit and enroll U.S. students will have only a small effect in producing more U.S. citizen Ph.D.s in the future. To achieve significant change will require increasing the number of U.S. citizens in the applicant pools of most science and engineering fields.

Many programs have been established to encourage American students to pursue careers in mathematics, science, and engineering. Most of these programs are directed specifically to minorities, and many of them have been discussed in a recent publication of the American Association for the Advancement of Science (AAAS) titled *Investing in Human Potential: Science and Engineering at the Crossroads*,[2] published in 1991. These include college and precollege programs designed to bolster skills in appropriate subjects and to provide opportunities to engage in research.

A particularly interesting kind of program is modeled on an early identification program begun at Johns Hopkins University and then extended to Duke University, Northwestern University, and the University of Denver. The Duke program, called the Talent Identification Program, involves students in 16 states and attempts to identify very bright students at an early age (grade seven). These students are assisted and advised through middle school and high school, provided with opportunities to take advanced courses in a variety of fields, and assisted in finding colleges and universities that have appropriate programs to match their abilities. The program makes special efforts to assist economically disadvantaged students and to promote racial and ethnic minority student participation.

The National Science Foundation has developed a number of programs that are aimed at improving teaching in mathematics and science at all levels and at facilitating minority student access to careers in these fields. In addition, NSF has maintained graduate fellowship programs for highly-talented American citizens that provide support for their graduate education.

Other agencies of the federal government, particularly HHS, the Department of Education, the Department of Energy, the Department of Defense, and NASA, support a variety of programs restricted to U.S. citizens to encourage students to pursue careers in the science and engineering fields, and to provide support to those who do.

Finally, many universities have developed programs to help identify, recruit, and graduate American minority students. Recent publications of the Council of Graduate Schools (attached) have provided specific examples of university programs, and of partnership programs involving research universities, historically black colleges and universities, Hispanic institutions, American Indian colleges, government laboratories and

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[2]Matyas, Marsha Lakes and Shirley M. Malcom, eds., *Investing in Human Potential: Science and Engineering at the Crossroads*, AAAS, Washington, D.C., 1991.

private research organizations. These programs are designed to encourage talented and capable American minority students to pursue careers in mathematics, science, and engineering.

These approaches are working. There are many examples of success. 1990 marked the third consecutive year in which the number of U.S. citizens who earned the doctorate increased. In that year U.S. citizens and permanent residents earned 66% of the Ph.D.s in the physical sciences, 77% of the Ph.D.s in the life sciences, 85% of the Ph.D.s in the social sciences, and 51% of the Ph.D.s in engineering. But the educational process is long and we are just beginning to see some of the fruits of these labors. Data from the CGS Survey of Graduate Enrollment (attached) shows increases in enrollments by American citizens, and marked increases by minority students starting in 1986 and continuing in each successive year. Since the average time between entry to graduate school and completion of the Ph.D. is about 6 to 8 years, we should begin to see significant increases in degree production starting this year.

The continuation of strong and stable federal support for the kinds of programs described here, plus increases in fellowship and traineeship funds for support of U.S. students is the best and most direct way to increase the number of U.S. citizens earning advanced degrees in mathematics, science, and engineering. H.R. 4595 will not accomplish this goal and could actually weaken graduate programs in mathematics and science by restricting their ability to enroll and support the best qualified students.

Mr. Chairman, this concludes my testimony. Thank you again for the opportunity to testify. I would be pleased to answer any questions you or your colleagues may have.

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BIOGRAPHICAL SUMMARY

JULES B. LaPIDUS

Jules LaPidus has been president of the Council of Graduate Schools in Washington, D.C. since September 1984. He received his bachelor's degree from the University of Illinois and M.S. and Ph.D. degrees from the University of Wisconsin. His field of specialization is medicinal chemistry. In 1958 he joined the faculty of The Ohio State University as Assistant Professor of Medicinal Chemistry, and was Professor of Medicinal Chemistry from 1967-September 1984. In 1972 he was appointed Associate Dean for Research at The Ohio State University and became Dean of the Graduate School and Vice Provost for Research in 1974. He is author or co-author of over 40 papers in the general areas of medicinal chemistry and pharmacology. He served on the Pharmacology and Toxicology Training Committee and the Pharmacology-Toxicology Program Committee, both at the National Institute of General Medical Sciences of the National Institutes of Health.

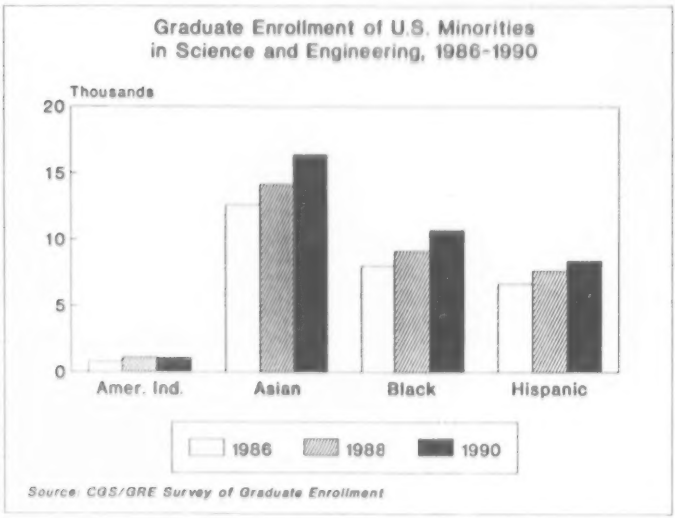
He has chaired or served on many committees concerned with graduate education and research in national associations including the National Association of State Universities and Land-Grant Colleges, the American Council on Education, the Association of American Universities, the Graduate Record Examinations Board, the African-American Institute, the Policy Council of the Test of English as a Foreign Language (TOEFL), and has been a member of advisory committees at the National Institutes of Health, the National Science Foundation, the National Academy of Sciences, and the American Association for the Advancement of Science.

November 1988

Affiliates
Conference of Southern Graduate Schools
Midwestern Association of Graduate Schools
Northeastern Association of Graduate Schools
Western Association of Graduate Schools

Graduate Enrollment of U.S. Minorities in Science and Engineering, 1986-1990

- U.S.-citizen and permanent resident graduate enrollment in science and engineering increased by 5 percent from 1986 to 1990.
- This overall growth was fueled by a substantial 30 percent increase in the enrollment of members of U.S. minority groups.
- Black Americans showed the largest gain in U.S. graduate science and engineering enrollment, increasing by 34 percent over the 1986 to 1990 period. American Indians, Asian Americans, and Hispanic Americans followed with increases of 33, 30, and 26 percent, respectively.



Prepared by the CGS Office of Information Services, 4/92

Graduate Enrollment of U.S. Minorities in Science and Engineering, 1986–1990

	1986	1988	1990	Percent Change *1986 to 1990*
Total U.S. Citizens and Permanent Residents	238,076	239,735	250,438	*5%*
Total Minorities	28,005	31,973	36,439	*30%*
American Indian	781	1,117	1,041	*33%*
Asian	12,587	14,134	16,366	*30%*
Black	7,975	9,112	10,670	*34%*
Hispanic	6,662	7,610	8,362	*26%*

Source: CGS/GRE Survey of Graduate Enrollment

THE
CGS IDEA
EXCHANGE

WINTER
MEETINGS
1990–91

ENHANCING THE MINORITY PRESENCE IN GRADUATE EDUCATION II: ASSESSING PROGRESS

THE CGS IDEA EXCHANGE

WINTER MEETINGS 1990–91

ENHANCING THE MINORITY PRESENCE IN GRADUATE EDUCATION II: ASSESSING PROGRESS

COUNCIL OF GRADUATE SCHOOLS

With Support From The Carnegie Corporation of New York

Trevor L. Chandler, Assistant Vice Chancellor, Diversity
University of California, Davis

Jules LaPidus, President, Council of Graduate Schools,
Washington, D.C.

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Foreword

As we prepare to enter the twenty-first century, it is important to acknowledge and to understand that all our communities will become more and more diverse. Our neighborhoods, our schools, and our work places will be populated by persons from a wide variety of social, ethnic and cultural backgrounds. Our strength as a nation will depend on our ability to use this diversity to enhance the quality of life for all of us as we live and work together.

Universities play a unique role in societal change. They are the places where the intellectual issues associated with such change are discussed and debated, and university scholars, through their research and teaching, help not only to shape the nature of the debate, but to prepare people to participate in the discussion. For this reason, it is particularly important that those engaged in this activity—students, faculty, and administrators—represent the diversity and understand the multiple perspectives of the society in which they and the university exist.

Graduate education, by preparing scholars, teachers, and leaders in all fields, occupies a critical position in this process, and it is in this context that we explore the role of graduate deans and college deans, faculty and other administrators in enhancing minority participation in higher education.

We are grateful to the Carnegie Corporation of New York whose generous support made these meetings possible. The Carnegie Corporation of New York is a philanthropic foundation that was created by Andrew Carnegie in 1911 to "promote the advancement and diffusion of knowledge and understanding among the people of the United States."

Jules B. LaPidus
President
Council of Graduate Schools

Trevor L. Chandler
Assistant Vice Chancellor, Campus Diversity
University of California, Davis

December 1991

Introduction

In the first series of CGS Idea Exchange meetings* graduate deans addressed the importance of getting more faculty involved in the process by which minority scholars are produced. Specifically, the deans discussed the role that they can play in encouraging that participation. Several suggestions were advanced, many of which hinged upon the graduate dean's ability to persuade the faculty. Since many graduate deans have only a tangential relationship to the process by which faculty are hired and promoted, it was recognized that their interaction with the faculty, though critical, was less direct than that which the department chair, the dean of the college, the provost, or the chief academic officer would have. The real influence that the graduate dean had in these matters, it was suggested, resided in the extent to which the dean and his/her office was involved in the allocation of funds to faculty and departments for the support of graduate students. These allocations provide leverage and can be used as incentives to encourage and promote supportive relationships and to increase contact between faculty and minority graduate students.

In addition to the allocation of student support funds, however, other activities were suggested in which graduate deans could play an important role. Deans can keep the issue of the minority presence on the agenda at the highest administrative levels of the university where the institution's commitment to these matters is formulated and communicated to the campus and the community at large. The role of the chief executive officers of the institution in the articulation of the message cannot be overemphasized, and deans who receive the support of their presidents and provosts usually find their attempts to enlist faculty support much more successful with such assistance than without it.

A function of the office of the graduate dean that is assuming greater importance is seeking external funding to support programs specifically related to enhancing the presence of minorities in graduate school. The use of these funds, usually administered by the graduate dean, can facilitate the intervention of that office in processes and activities that are designed to increase the contact between faculty and minority graduate students.

The administrative organization of the university is also a determinant of the level of influence that can be brought to bear by the graduate dean's office. Greater influence can be exerted in cases where the role of the graduate dean also includes the administration and coordination of the research efforts of the faculty. In these cases, not only is the dean aware of the research projects being conducted by faculty, but, through a wide variety of communicative means (notices, flyers, meetings, etc.) can bring directly to the attention of the faculty ways in which they can involve minority students in research activities and thus support the university's commitment to increase the production of minority scholars. Toward this end, a major suggestion

*_Enhancing the Minority Presence in Graduate Education_. The CGS Idea Exchange, Spring Meetings, 1988. T. L. Chandler and J. B. LaPidus, Council of Graduate Schools, Washington, D.C., 1988.

was that graduate deans should have in their offices a person, at an administrative level high enough to command the respect of the faculty, who in addition to his/her other duties, would have the responsibility of coordinating the effort to increase the minority presence, and beyond that, of assisting in the development of a supportive academic environment for graduate students of color.

In the current series of meetings, graduate deans reviewed their efforts to implement the ideas suggested three years ago. In particular, they noted what new programs have been developed and how the faculty have been encouraged to participate in the process. Moreover, they shared the successes and failures, as well as the problems and any other institutional obstacles that have been encountered in the process of implementing these programs. Part of these meetings was spent in addressing how graduate deans are preparing their institutions to meet the challenge of the rapid demographic changes taking place in American society. All projections indicate that accelerated population growth among specific ethnic and cultural groups is likely to have a dramatic effect on higher education. Given the need for new faculty to replace the current faculty, 48% of which were 50 years old or older in 1989, it is important to understand the urgency to prepare more women and students of color for the professoriate.

In keeping with the commitment to make these sessions useful and productive, the participants spent most of their time discussing what is *doable* and within the purview of the graduate dean. They also shared information about some of their most successful recruitment and retention efforts. What follows is the outcome of their discussions.

Major Conclusions of the Meetings

- Graduate deans are playing a more active role in the development and implementation of programs designed to enhance the presence of minorities and women in graduate school.
- Graduate deans are finding it easier to elicit the support of faculty, especially younger faculty, in efforts to create a supportive environment for minority graduate students.
- At many institutions the infrastructure for the support of minority graduate students is now in place.
- Most universities have in place activities that are designed to increase the numbers of minority graduate students at the institution.
- Funding agencies that require direct faculty/student interaction enhance the ability of graduate deans to develop effective mentoring programs at their institutions.
- The institutional competition for grants to support graduate students is causing institutions to develop track records for producing and supporting minority graduate students.

- The availability of an independent source of funds provides graduate deans with the leverage to enhance and increase faculty and departmental support for minority graduate students.
- The Summer Science Research Programs (SSRP), the Early Identification Programs (EIP), the Minority Access to Research Careers (MARC), and the Patricia Roberts Harris (PRH) Program are cited as major contributors to the continuation of effective long-term faculty/student relationships.
- At many institutions the graduate dean is the principal advocate for increased enrollment and retention of minority graduate students.

Factors Affecting the Role of the Graduate Dean

Graduate deans have recognized and accepted the pivotal roles they play in the production of minority scholars. Consequently, the drastic reduction in Ph.D. production in the last ten years occupies much of their thinking. This is part of the broader concern about the pool of qualified undergraduate students and the pipeline which produces them. Serious thought is being given to working with teachers in the elementary and secondary school systems and to the development of more effective articulation between the community colleges and the universities. Recently, in the state of California, David Gardner, President of the University of California, proposed, primarily as a cost-cutting device, the transfer from the university to the community colleges of all remedial and/or courses designed to enhance the level of preparation for entering students. Although this proposal has created some concern, it has nonetheless suggested a new role for community colleges in the preparation of students who desire to pursue degrees at the University.

M.R.C. Greenwood, Dean of the Graduate Division at UC Davis, explained the several parts of the Davis strategy employed by the institution to enhance the minority presence in graduate programs there. The division has set as a short-term goal "to enroll domestic students from diverse backgrounds in at least the same proportion they are receiving bachelor's degrees in the nation," and a long-term goal "to enroll, retain, and see to graduation domestic students from underrepresented ethnic groups in the proportion they are represented in the California population." To achieve these goals, the institution has a wide-ranging set of programs beginning in elementary school at the third grade. They are followed by programs for junior high and high school students. The Transfer Opportunity Program links the university with the community college system providing preparation and transfer opportunities for prospective undergraduate students. The Special Transition Enrichment Program (STEP) and the Biology Undergraduate Scholars Program (BUSP) are well-known undergraduate programs at Davis designed to enhance the success of students of color entering the university for the first time.

The concern for the success of students and the strengthening of the pipeline does not end with the offering of academic support programs for the student. There is an equal necessity to create an environment that will enhance the probability of success for students who had hitherto been severely underrepresented in the academy. The

diverse backgrounds of the California population coupled with the rate of growth of the non-white ethnic groups create a unique and challenging situation for educational institutions in the state. The complexity of the situation in California is captured in the following quotation taken from the *Report of the 1990 All-University Faculty Conference on Graduate Student and Faculty Affirmative Action*:

> By 2005, California's population is projected to grow by 22 percent—from 28.3 million to 34.5 million. Between now and 2005 the K-12 population—the population from which we select our students—will grow at the rate of 50 percent—and the tenth grade population in California public high schools is projected to be 11.5 percent Asian, 10.1 percent Black/African American, 33.2 percent Hispanic, and 45.1 percent white (based on 1987 births). Thus, students who have been historically underserved by the education system—Asian Americans, Blacks/African Americans, Chicanos, Latinos, Native Americans, and others—and who, for decades, have been characterized as a "minority" constituency, are fast becoming the majority of California's school age population. (p. 3)

The learning and teaching environment assumes new importance in such a situation and every attempt is being made to add persons of color to the faculty, staff, and administration, and to assure that all students have an enriched quality of institutional experiences while pursuing their courses of study. This diversification of the university has the highest priority and is recognized as a critical element in the successful production of future minority scholars.

Graduate deans engage in a wide variety of relationships with faculty and other administrators in carrying out their daily tasks. Many of these relationships are defined by the nature of the position and by the accepted practice of deaning. One of the major observations in the first round of discussions by graduate deans was the perception of the limited power they had to effect change in the way faculty interact with graduate students. In the current set of discussions, however, a variety of programs and policy changes which have become common to the operations in graduate schools throughout the country, were perceived to have altered that perception of powerlessness and to have given graduate deans a new sense of their ability to influence the relationships between faculty and minority graduate students. These changes in university policy address, in comprehensive fashion, the role of the institution in successfully fulfilling its mission to educate all segments of the population. "The Michigan Mandate" and "The Wisconsin Initiative" were cited as examples of such policies, derived by a process of extensive consultation concerning the future directions of education in these states. The power and authority of the graduate dean, and how the graduate school fulfills the role of maintaining excellence in research and teaching at the institution, formed a large part of the discussion in this round of meetings.

The effectiveness of the dean in promoting change inevitably involves the relationship between the graduate dean and the faculty, especially in their roles as mentors and sponsors of graduate students. The particular problem of promoting cross-

cultural relationships and research between faculty and minority students has always been cited as a difficult one for deans. This situation has improved somewhat over the years even though the attitudes, beliefs, and behaviors of many faculty, with respect to providing guidance in these areas, have not changed. In addition, the ratio of white to minority faculty at many of the major institutions of the nation has remained relatively constant over the last ten years, consequently minimizing the effect which an increase in the number of non-white faculty may have in solving this problem. In 1989 that ratio among faculty in four-year institutions remained at 92% white to 8% non-white.

Perhaps the most important factor in the discussion of proposed changes relates to the allocation of resources. In most instances, an increase in the current expenditures for the improvement and enhancement of the minority presence on the campus is required. Without such an increase, the recruitment and retention programs at the institution are likely to suffer. These programs generally fall within the purview of the graduate school and provide the dean with the means to affect in a positive way the chances of success for minority graduate students. Programs that require faculty involvement and support at an early stage in the student's academic life, as well as agreements by the departments to support students who also receive financial assistance from the graduate school, are becoming more commonplace. These activities promote the integration of the student into the life of the department and prompt faculty interest in their success. Without such interest, students are likely to miss the opportunities to learn the "culture of the discipline" and to benefit from the advantages derived from a close working relationship with a faculty member.

An increase in these budgets, such as occurred at the University of Michigan, allows for the generation of a number of funding programs which require departmental matching funds. By these means, the graduate dean's opportunity to "leverage" resources is greatly enhanced. However, there is some concern as to the limit of these budget increases and the capacity of the institution to continue to provide guarantees of future funding, as both the numbers of minority students grow and the cost of education increases. This is true at all institutions, but especially at those where programs for increasing the numbers of minority graduate students have been dependent upon the creativity of the dean's office, or where generally tight budgets limit the implementation of programs which result from such creativity.

Leveraging has become an increasingly important role for the graduate dean and his or her office staff. Not only is the office able to bargain with departments for matching funds for student support over time, but in the process faculty time is also leveraged. An interesting phenomenon resulting from these bargaining activities, is the increase in voluntary faculty commitment to these efforts. This seems to be gaining greater acceptance particularly with new faculty. Student interest in continuing to pursue advanced degrees also is affected by these leveraging activities. Programs which require students to repay loans with service, especially if they attain the highest degree in the field, provide incentives to persist to degree completion. In some cases, through the graduate school, the university has been able to affect the

"pipeline" by providing summer research opportunities to high school students with the promise and purpose of encouraging their entry into the university. The Ohio State University has a well-established reputation in this area and other institutions have recorded great success in similar endeavors.

Further discussion on maintaining the minority presence in graduate school revealed a number of additional roles and responsibilities that fall to graduate deans. How to remove the stigma that is attached to any assistance which minority students receive demands constant attention, since the perceptions of these activities that prevails in the department or on the campus can greatly influence the "academic climate" experienced by these students. There must be an intellectual basis for the support of minority students on the campus, and the graduate dean can lead the discussions regarding that subject at all levels of the institution. One such discussion can relate to redefining the fellowships for which minority graduate students apply by emphasizing the academic requirements rather than the minority or gender-based qualifications. Faculty participation in the selection of the students who receive these merit fellowships or other awards is critical. Also, the dean's office should develop methods or mechanisms for continued demonstration that these recipients are indeed worthy of that recognition. The academic basis for providing support for minority students, in conjunction with whatever legal and moral justifications apply, form the context for arguments made to strengthen the programs that affect the minority presence. Many of the deans present had such programs in place and used them to help in structuring and maintaining their faculty mentor activities.

One of the most critical roles of the graduate dean is to emphasize the importance of graduate education in the life of the academy. This is especially necessary at institutions where the leadership emphasizes the importance of undergraduate education, sometimes to the seeming exclusion of the graduate level. The dean encourages departments to develop initiatives in support of student enrollment and retention where policies and programs do not exist. The support of minority graduate students is one area where such initiatives are necessary. Where decentralization exists, duplication of effort and programmatic initiatives may result in wasted resources. The office of the graduate dean may have the responsibility to minimize this potential duplication especially in areas of identification, recruitment, and retention of minority scholars.

These roles of the graduate dean as they are translated into the responsibilities of his/her office, find expression in several different types of activities. They may range from involving the university in activities designed to identify qualified applicants, to the creation of faculty/student linkages after these applicants are admitted to the institution. At Duke University, the activity of the office of the graduate dean is driven by three goals: (1) to increase the number of students of color in all graduate programs; (2) to provide adequate long-term funding to enable the completion of graduate degrees at the university; and (3) to create an academic and social environment that will enhance the achievement of students of color.

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At many institutions these goals are contained in academic plans, such as those of the University of California; five-year programs, as are demonstrated by The Madison Plan of the University of Wisconsin; and in mandates linking legislative and academic concerns with education as exemplified by The Michigan Mandate of the University of Michigan. *A Vision for Duke* outlines the approach and position of that university with regard to these issues. It contains a statement of the president's support which everyone agrees is necessary if these programs are to succeed. The *Vision* also contains surveys of the attitudes of students of color as the institution attempts to respond to their presence on the campus.

One of the outcomes of the publication of *A Vision for Duke* is a heightening of the sensitivity of the university to the issues which the growing presence of persons of color normally generate at a formerly predominantly white institution. This, in Duke's case, led to symposia for all campus personnel, as well as to the development of programs targeted especially to the needs of minority students. Symposia were also begun in the graduate school and supported by private funding sources. More significantly, both the campus community and the larger Durham area were encouraged, through a series of activities labeled "Black on White," to seek ways to expand outreach efforts to the minority populations and to examine methods to create a more hospitable campus climate for the minority students at the institution.

New roles will accrue to graduate deans as they address these issues. The control of resources provides the dean with leverage to persuade faculty to become more involved in the lives and education of graduate students of color. This activity is supported by conditions recently added to grant awards from several federal granting agencies requiring greater involvement of minorities and women. The graduate dean's office, as the institutional unit generally responsible for writing the proposals for the several types of institutional grants contained in Title IX through the Department of Education, has an excellent opportunity to promulgate these conditions and to help units satisfy them.

Trends in Graduate Enrollment

Graduate enrollment has been increasing steadily by about 2% per year. There have been impressive increases in the participation of women in graduate education. However, there is still difficulty in attracting women into bench science areas such as physics, chemistry, mathematics, and computer science. The enrollment data for persons of color in graduate programs show increases in the last few years, but so far this has not resulted in an increase in the production of Ph.D. degree recipients. This is related at least in part to the length of time required to complete the degree.

Trends in Graduate Enrollment at CGS Institutions: 1986–1989, prepared by the Council of Graduate Schools, documents the increase in minority enrollments in graduate programs at CGS member institutions and shows that the percentage increase ranged from 6 percent for Asian Americans to 2 percent for native Americans. During the same period African American and Chicano/Latino enrollments increased by 5 percent. Despite the fact that there were more women than men enrolled in graduate

programs in the fall of 1989, there was a slight percentage increase in the number of Asian Americans, African Americans, and Chicano/Latino men enrolled in graduate programs.

These increases in enrollment, particularly for African Americans, may signify a reversal in some of the declines experienced during the early 1980s. That, coupled with increases in undergraduate enrollment and degree attainment since the mid-1980s, provides great opportunities for aggressive recruitment and retention activities on the part of graduate schools. The next section will describe some of these activities at a number of institutions.

Selected Programs and Activities at Participating Institutions

Over the past three years many institutions have developed or expanded a number of programs that have contributed to increasing the recruitment and retention of minority students in graduate programs. Although there are similarities, each institution tends to develop initiatives that are unique to the particular setting. This section provides highlights of some of these initiatives to give an indication of the variety and scope of the activities currently taking place. It is too early to evaluate fully programs initiated since the graduate deans met three years ago. However, it is clear that some institutions have developed approaches which increase significantly the number of graduate students from underrepresented groups and the involvement and support by the faculty. Noteworthy among these approaches is the summer research opportunity program for undergraduates, which was mentioned by many of the participants at this meeting as being particularly successful, not only from the students' point of view, but for the faculty as well.

Arizona State University

Networking Structure. Efforts have been focused on building network support structures. A survey of faculty was undertaken to provide an opportunity for faculty to indicate their interest and support for minority students in specific programs. Faculty support ranges from employing students on faculty research grants to providing mentoring support. There are two related programs. The first provides peer mentoring, faculty support, and financial aid to students who would not have otherwise been admitted. The second is an identification program in conjunction with the Community College System to set up pre-college support and carry it through into undergraduate and graduate programs.

California State University, Fresno

Synergistic Model to Increase Persons of Color in Graduate Programs. During the period 1985–91, the number of African-American graduate students increased three-fold and the number of Hispanic graduate students doubled. The Division of Graduate Studies and Research serves as the focal point in the development of a substantial group of minority students engaged in studies leading to a master's degree as a step in preparing to transfer to doctorate-granting institutions. Synergy is

evidenced in enhanced cooperation among all levels of the university, including administrators and staff in the key support agencies housed in undergraduate student affairs, the corps of graduate program faculty advisors, the administration and transfer offices of regional community colleges, and contacts at other universities. Local minority community organizations and media are cultivated as a means to reach potential students, and to inform parents and families. Family members are invited to accompany pipeline students participating in such events as the undergraduate minority student achievement honors reception, minority student summer research program final poster session, and minority graduate fellowship reception. This engagement in cooperative action by many entities has created enthusiasm for finding new opportunities to augment the number of minority students in all levels of the pipeline to graduate studies. Details concerning some specific activities in the synergistic model are provided below.

Summer Research Program for Undergraduate Minority Students. Under Title IX, Higher Education Act, CSUF to date has obtained funding in support of 110 undergraduate minority students. This summer enrichment program develops the research skills of the undergraduate minority participants and encourages them to pursue advanced degrees through graduate education. This program focuses on the establishment of a student/faculty research team. The team is involved with research and the preparation of a formal presentation as well as travel to major research facilities throughout the state. This travel to major Ph.D. institutions broadens the horizons of student participants since there is no university granting the Ph.D. in the region served by CSUF.

Visiting Scholars Program. This program has been under way for some time. Through it, doctoral students of color who are completing their degrees are invited to CSUF to make scholarly presentations concerning their research to students and faculty.

Administrative Assistantships. Three graduate student administrative assistantships have been established in the Division of Graduate Studies and Research. Currently these assistants are from underrepresented groups. Fellow academic school deans have followed the lead of the graduate dean in the establishment of administrative assistantships and in the commitment to providing opportunities for minorities. The assistants are invaluable in facilitating outreach to encourage minority participation in graduate education, and in coordinating the orientation and monthly follow-up of students in specially funded programs such as McNair and Patricia Roberts Harris. Other assignments include the conduct of surveys, the analysis of data and the drafting of reports concerning graduate studies.

California Predoctoral Program. The Division of Graduate Studies at CSUF has been an active participant in the California Predoctoral Program, providing leadership in the conception and implementation of the program. Initiated three years ago in 1989–90, this program is the result of cooperative efforts of the California State University (CSU) and the University of California (UC). Its purpose is to increase the number of CSU minority students, disabled students and women students in UC

doctoral programs in disciplines in which they are underrepresented. The Predoctoral Program provides for the nomination of undergraduate and master's-level students from universities in the CSU to receive summer stipends of $2,000 and academic year support of $3,000. Under the direction of CSU faculty members, students design a program of study for the fall and spring semesters as well as a summer program of research. Selection into the program is carried out by a Joint CSU-UC Advisory Board. To date, 175 fellows have received awards with 75 to 80 percent of prior cohorts of graduates entering doctoral programs in the UC. Funding for this program is provided by the California Lottery.

Duke University

One institution that has had impressive results is Duke University. Duke's activities and programs, based in part on CGS recommendations, may serve as a model for other universities. The Office of Graduate Recruiting was established in 1987 to centralize and coordinate graduate student recruitment. Meetings were held with each department to get a sense of what was being done. The September-October 1987 CGS *Communicator* article on "Graduate Student Recruitment" provided the initial model for Duke to develop a comprehensive recruitment program which emphasized assessing university efforts, setting goals, and developing strategies. Three goals were set:

- Increase the number of students of color in all graduate programs
- Provide adequate funding so that students could complete degrees at Duke
- Create an academic and social environment of support for persons of color.

Then strategies were developed to meet the three goals:

- Expand regular recruiting activities
- Hold individual meetings with graduate students of color
- Involve the entire institution through symposia that focus on various aspects of minority participation in higher education.

The first symposium was entitled "Black on White" and addressed access, feelings about students of color, sororities and fraternities, different views of black students compared to white students, and other issues. Workshops were facilitated by outside persons to remove any threat to faculty, staff, and students. Among other things, the symposium identified the need for multi-cultural workshops, the need to have students understand value diversity, the need to restructure the Afro-American Studies Program, and the need to incorporate into the regular curriculum more information on different cultures. Other activities that have been implemented are:

- *A Vision for Duke*. This set of materials contains a letter to students from the President about the value of diversity. It also contains questionnaires directed at new and continuing students concerning their attitudes to the increased presence of students of color on the campus.

- **Graduate School Symposium.** Every October the Graduate School hosts a symposium for students and faculty to address topics related to the creation of a supportive learning and teaching environment for students and faculty of color on the campus.
- **Academic Council Resolution.** Two years ago the Academic Council passed a resolution requiring all academic units to have at least one black faculty member by 1993. This resolution put responsibility for implementation directly in the hands of the department chairs.
- **Hurston James Society.** Through the support of the Hurston James Society, a group of Ph.D. students of color are able to meet on a regular basis to talk about their academic interests in a multidisciplinary setting. Faculty are involved and students present their work in progress.
- **Dana Scholars Program.** Through a grant from the Charles A. Dana Foundation, undergraduate students at five historically black colleges with a history of producing graduates who go on to complete the Ph.D. degree are provided with support for academic year research activities at their institutions and a six-week summer research program at Duke.
- **Collaborative Consortium.** In collaboration with the Consortium on Financing Higher Education (COFHE), Duke has spearheaded the minority Graduate Pipeline Project. The project is designed to bring representatives of COFHE graduate schools to the campuses of COFHE colleges and universities to meet with selected undergraduate minority students. During this one-and-a-half day seminar, students are given the opportunity to meet informally with graduate school representatives, as well as faculty and administrators from their own campuses, to learn about the various graduate school opportunities available to them. Unlike the familiar "graduate school fairs," the purposes of the seminar are for information and inspiration rather than for direct recruitment.

The Florida Agricultural and Mechanical University School of Graduate Studies, Research, and Continuing Education

Graduate Feeder Scholar Program. The Florida Agricultural and Mechanical University (FAMU) Graduate Feeder Scholar Program (GFSP) was initiated in May, 1987 with 12 universities. Today, it is an arrangement with 25 doctoral degree-granting institutions that have agreed to reserve three to five admission/financial aid packages annually for qualified FAMU graduates who wish to pursue advanced degrees, especially the doctorate.

Over 350 nominees have been sent to the 25 institutions and currently there are approximately 65 students enrolled in graduate programs. Feeder institutions provide tuition, room and board, waiver of the application fee, stipend for books and substantial stipends and/or assistantships/fellowships to qualified applicants.

FAMU's obligation is to provide the feeder institutions with a list of 100–150 potentially acceptable students each year. Sophomores, juniors and seniors are

encouraged to apply and should have at least a cumulative GPA of 3.0, be a U.S. citizen, and be willing to study at major universities across the United States.

An annual Feeder Conference is held to plan and evaluate the progress of the program and to make recommendations for the future. This year's conference is scheduled for November 3–5, 1991, at Florida A & M University.

The FAMU Summer Graduate School Orientation Program for Black Graduate and Professional Students. The State University System (SUS) Summer Graduate School Orientation Program for Black Graduate and Professional Students is designed to identify and motivate black students with the potential for graduate and/or professional education, and to acquaint them with career opportunities related to these studies. The program is targeted primarily for fields where blacks are underrepresented.

Fellowships of $1,300 are awarded to 20 fellows. Each student uses the award as he/she sees fit to defray registration and other expenses regardless of the length of a particular term. Summer Orientation fellows receive six semester hours of graduate credit upon successful completion of the term.

The Minority Participation in Graduate Education Program (MPGE). The FAMU MPGE program, funded under Title IX of the Higher Education Act of 1965, is designed to heighten the interest of minorities in graduate education during their undergraduate years. The program involves minority students who are talented, but needy, from FAMU and other colleges and universities within a 500-miles radius of Tallahassee. Sophomores, juniors, and seniors from eligible minority groups are selected for the all-expense paid summer research experience. The program design pairs 14 FAMU students with 14 students from other schools, by discipline and classification, to work in teams of two in ongoing research activities with established research professors. Students participate in the program for eight weeks and receive six semester hours of credit for their participation.

Fordham University

Name Exchange. The graduate school started a name exchange program with over twenty-eight institutions across the country. Bilateral name exchanges help identify students who are interested in pursuing graduate study at other institutions. It is also attempting to organize a central name exchange with the other 27 members of the Association of Jesuit Colleges and Universities (AJCU).

Outreach to Undergraduates. The Graduate Student Association has become involved in outreach to undergraduates and this has been very successful in increasing interest in graduate studies.

Minority Tuition Funding. Minority students accepted into graduate programs in psychology receive tuition funding for three years.

Also worth noting is the fact that the AJCU has recently established a special competitive scholarship for minority students attending Jesuit institutions which will fund doctoral studies at Jesuit institutions.

National Aeronautics and Space Administration (NASA)

GSRP Underrepresented Minority Focus (UMF). In 1987, GSRP was expanded to include the Underrepresented Minority Focus (UMF) component, which was created to increase minority participation in graduate study and research and subsequently in space science and aerospace technology careers. This component was added as a result of NASA's concern that minorities remain significantly underrepresented in science and engineering. Students selected for participation collaborate with university investigators and NASA personnel, either from Headquarters or a field center, depending on the manner in which they were selected.

Eligibility. U.S. citizens who are full-time students at an accredited U.S. college or university and are members of an underrepresented minority group are eligible. (An underrepresented minority group is one whose members are not represented in science and engineering fields in proportion to their numbers in the general population. The following minorities fall into this category: blacks, American Indians, Hispanics and Pacific Islanders.) This program enlists the assistance of university principal investigators and graduate faculty advisors in locating promising minority graduate students.

Application Procedures and Deadlines. Interested students are encouraged to obtain the program booklet. Application deadline is February; notification of award is late April.

Award Provisions. One-year, $22,000 fellowship, renewable for up to three years.

For more information: University Programs Branch, Educational Affairs Division, Mail Code XEU, NASA Headquarters, Washington, D.C. 20546 (202/453-8344).

New Mexico State University

Visits with Undergraduates. Representatives from the graduate dean's office visit with undergraduates to discuss graduate opportunities. This program provides information about graduate educational opportunities in general, but does not necessarily engage in specific recruitment for the institution.

Graduate Assistantships. A department's record in recruiting and retaining minority graduate students is being used by the graduate school as one criterion in the allocation of graduate assistantships.

Policy for Funding Minority Students. The dean's office has funds to provide support for minority students. The result of this support is a slow and steady increase in the proportion of women and persons of color in graduate programs. The aim is to match the proportion of graduate students with their representation in the groups receiving baccalaureate degrees.

North Carolina Agricultural & Technical State University

Advocacy Role. A major role of the graduate dean is to serve as an advocate for minorities entering Ph.D. programs. North Carolina A&T is recognized as one of the

leading institutions for training black engineers, agriculturists, and educators as well as other scholars, and is a feeder institution for many graduate programs throughout the country. In the past few years North Carolina A&T has developed cooperative doctoral programs in engineering with North Carolina State University. A proposal for mission change may lead to more advanced degree programs at this university.

Recruitment. There are both undergraduate and graduate career days on the campus where information on programs is provided to students. In attendance at these events are representatives from some of the premier institutions in the country that offer master's and doctoral degrees and that wish to recruit North Carolina A&T baccalaureate and master's graduates. By the same token, the graduate dean and other members of the graduate faculty are involved in the process of recruiting minority and other students who wish to study at North Carolina A&T and who eventually move on to doctorate-granting schools.

Northern Illinois University

Since the early 1980s Northern Illinois University has had a minority assistant dean in the graduate school.

Recruitment Efforts. The university has a rather large budget and an extensive recruitment program which includes follow-up of letters and tracking. There is a minority recruiter and three assistants. There is a Department Recruitment Fund in the graduate school and 30 departments were funded this last year.

The recruiter travels extensively to minority and professional career days and particularly to minority and historically black colleges and universities. Through these contacts, the recruiter has developed a rapport with colleagues in various institutions and a successful recruitment track record.

Minority graduate students may be given up to twelve months of tuition waivers by applying either to the department or to the graduate school. The graduate school makes an effort to assist students financially until the department can award an assistantship.

Minority Graduate Student Reception. Once a year there is a reception for minority graduate students.

Graduate Student Organization. This organization plans to get involved in Black History Month and has started a colloquium series.

Aurora-University Project. This is a pipeline program that brings together school districts, businesses, and community colleges in Northern Illinois and Aurora to address getting students into the teacher education program.

Northwestern University

Northwestern has developed a number of approaches to providing financial support for minority students. With additional funding, primarily for fellowships and recruitment, during 1989–90, the number of incoming minority students has doubled and outside funding has increased more than 60%.

Minority Fellowships. The Graduate School had two fellowships in 1988–89 and in 1989–90 it was able to make 40 fellowship offers. Funding is guaranteed for four years. To encourage departments to admit students with "nontraditional credentials," the Graduate School funds the first year which is the high risk year and the department then funds the next three years. Departments nominate students for these fellowships and there is a 48-hour turnaround in the review process.

Graduate Student Recruiting. The minority fellowship program was coupled with a vigorous program of off-campus recruiting. In addition, for minority students who have applied to Northwestern, the Graduate School pays $200 toward their travel expenses to visit the campus. The departments frequently supplement this amount as necessary.

Quarterly Receptions for Minority Students and Faculty. These programs have been expanded. The fall reception includes continuing students and minority faculty who share their experiences to help new minority students get oriented to the University and the community. One winter quarter reception includes faculty and undergraduates interested in the Summer Research Opportunity Program (SROP); the second reception, which includes graduate students and faculty, honors past SROP participants and their faculty mentors, who are also guests. Minority graduating students are honored at the spring quarter program and receive a special t-shirt.

Ohio State University

Summer Research Program. There are 70–75 students in the Summer Research Program. It is one of the most successful programs to encourage students to think about graduate education. It also significantly increases faculty awareness about the capabilities of outstanding minority students. It has prompted faculty to take students to professional meetings.

Recruitment Efforts. Graduate and Professional Student Visitation Days are a component of the minority recruitment program of The OSU. Historically black institutions are asked to send their five most outstanding senior students to Ohio State University for several days. The students visit the campus, speak with faculty and graduate students, and are invited to make an application to graduate study. There is a recruitment grant program that makes funds available to departments to undertake special recruitment activities. Also, a volunteer group of faculty, staff, and administrators sponsors graduate recruitment fairs and is involved in various aspects of graduate recruitment.

Young Scholars Program. The Young Scholars Program identifies students in the 6th grade and brings the students to campus for two weeks in the summer. These students continue with the program each year, and if they enter The Ohio State University they are guaranteed a four-year scholarship.

Princeton University

Expanding the Pool and Faculty Education. Princeton has initiated summer research programs which bring Minority Access to Research Careers (MARC) students and

students from non-research institutions to campus for 8 or 9 weeks for research experience. One of the most beneficial effects of these programs has been to educate the faculty about the capacity of these students to do work at the level expected by Princeton's faculty. Additional funds, from the President's office, are given to departments to search for and hire minority faculty members. At the graduate level, funds are made available from the same source for up to twelve fellowships for minorities in any discipline and for women in science and engineering.

Graduate School Working with Undergraduate Deans. A grant from the Mellon Foundation supports ten undergraduate Mellon scholars for their junior and senior years and up to two summers in the humanities and social sciences to interest them in going on to Ph.D. study.

Temple University

Future Faculty Fellows Program. With a $1 million budget, this program supports twenty to twenty-five new minority students per year. Students must be admitted to a graduate program at Temple University, intend to pursue a career in higher education, and enter a field where their ethnic group is underrepresented. The fellowships provide full tuition remission and a stipend ranging from $7,500 to about $14,000. Support for doctoral students is for four years—two years' support from the dean of the graduate school and two years' support from the department. The Future Faculty Fellows Program requires faculty to take an active interest in the careers of the recipients of these awards.

Summer Sciences and Engineering Program. An important aspect of the Summer Sciences and Engineering Program is to encourage students to think about graduate programs at an early enough stage in their education to affect their choices and opportunities for graduate study. Between twenty and forty minority students are brought to campus each summer to gain laboratory experience at a major university. They are assigned to a researcher and work in a lab as part of a team. Some of the participants have been recruited into the Future Faculty Fellows Program.

Support of Minority Post-Doctorals in the Sciences. This support is available for persons when such training is deemed to be a necessary part of the preparation for a faculty position.

Institutional Policy Change. Temple will now consider hiring its own Ph.D.s.

Towson State University

Financial Assistance. Towson State sets funds aside for minority student fellowships. The funding level is relatively small compared to that of many other institutions. Many Towson State students have outside jobs while attending the university so that the provision of some financial assistance is an important incentive.

Effort to Increase the Enrollment Rate. A letter-writing campaign organized by the graduate school has been successful in increasing the number of minority students who enroll in graduate school.

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Minority Speakers Program. Funds have been available to bring speakers in as role models, but this program has not been highly utilized.

University of Arizona

Graduate Enrollment Increases. From 1987 to 1989–90, the number of Hispanics has increased by 112%, African Americans by 71%, American Indians by 40% and Asian Americans by 20%. Asian Americans have not been a targeted group.

American Indian Graduate Center. The University has established a center with a full-time director and staff. This center, located in a house near campus, provides an opportunity for American Indian students to gather and engage in cultural, social, and academic activities.

Other Programs. Other programs that have been developed include: (1) a Summer Research Program called "ACCESS" which is funded by the Department of Education ($89,000 a year, 1989–91); (2) The Presidential Dissertation Fellowships for Women and Minorities ($100,000, 1989); (3) a Minority Graduate Student Development Fund that provides funds to help students develop their research ideas (approximately $5,000 a year); (4) The Minority Graduate Student Travel Fund for students to present papers or posters at national and regional conferences (approximately $10,500 a year); (5) The Faculty Innovative Minority Retention Plan for the initiation of creative retention programs for minority students at the departmental level ($17,200 in 1987–88, $28,285 in 1989–90); (6) The Community College Visiting Scholars Program which funds two minority graduate students to gain experience in community college teaching with large groups of minority students; and (7) The Master's Program for Minority Journalists, funded partially by the Graduate College, for minority students pursuing a master's degree in journalism during the summer.

University of California, Davis

UC Davis, as the host campus for the first meeting of the second round of the graduate deans' meetings, presented comments by both the Academic Vice Chancellor and the Dean of Graduate Studies.

Vice Chancellor—Academic Affairs: Meetings with Departmental Faculty. The Vice Chancellor—Academic Affairs conducts meetings with departmental faculty to discuss faculty recruitment and hiring. These meetings help prepare faculty to participate in the recruitment/hiring process and to receive and support new faculty who are women and persons of color in departments where they are underrepresented. Most important, these meetings make clear the university's policies related to faculty hiring as well as its commitment to diversity.

Graduate Dean: Status Report on UC. The campus is working to improve the financial support available to graduate students by coordinating support that is available through the Graduate Division, Financial Aid Office, and the individual graduate programs. Women's entrance into graduate programs where they are underrepresented is good. Progress in increasing the numbers of persons of color from underrepresented groups into graduate study is slow but steady.

It is difficult to attract and retain students of color without faculty role models and mentors. In this regard, the university has taken an aggressive role in hiring women and persons of color as faculty members. For example, the College of Engineering has employed a series of approaches aimed at all stages of the educational pipeline that has helped to increase the presence of women and persons of color in its graduate programs and on its faculty. This includes participation in the statewide Mathematics, Engineering, Science Achievement Program (MESA), year-round enrichment programs and pre-University admissions and matriculation advising for students from the third grade through community college; the Engineering Summer Residency Program (ESRP), a one-week residential program on the campus, for high school juniors and seniors; the Minority Engineering Program (MEP), academic support and advising for undergraduate engineering majors; Minority Opportunities for Research in Engineering (MORE), academic year and summer research internships for upper division and graduate students; the Research Assistantships in Engineering Program and university graduate fellowships; and the Target of Opportunity Program for the recruitment of faculty. All program components are administered and coordinated through the College of Engineering Dean's Office.

University of California, San Diego (UCSD)

Efforts to Involve Faculty Participation in Graduate Student Affirmative Action Activities. At UCSD, each department appoints a faculty member to serve as the graduate affirmative action adviser. This person's responsibility is to develop a departmental strategy, to plan outreach efforts, to assist admissions committees in evaluating affirmative action applicants, and to look out for the interests of enrolled affirmative action students.

Each year UCSD awards approximately 35 new two-year affirmative action fellowships. Each fellow is assigned a faculty mentor for whom the fellow serves as a quarter-time research assistant (RA). The mentor, in addition to providing RA supervision, is responsible for guiding preparation during the summer prior to the first year of study, advising about course selection, and integrating the fellow into the mainstream of departmental life.

UCSD has a summer research experience program that accommodates approximately 125 affirmative action students. This program involves the participation of about 100 faculty members who serve as mentors. Their duties include providing participants with a meaningful research experience and encouraging them to consider and prepare for applying to graduate school.

Finally, the Graduate Office has a modest amount of funding to support faculty members who will undertake visits to colleges and universities with large minority enrollments and discuss with faculty and students the opportunities for graduate education at UCSD.

University of Chicago

Summer Research Opportunity Program for Undergraduates. This program is most successful in keeping undergraduates in college and stimulating them to go on to

graduate study. The Summer Research Program involves faculty as mentors and serves to get faculty interested in the academic abilities of minorities and in serving as mentors during the next year.

Socialization and Integration of Undergraduate and Graduate Students. The Minority Graduate Student Association was formed in part to establish a graduate student mentor program. This program provides undergraduate students an opportunity to become more involved with graduate students.

Faculty Advising. Work continues toward the goal of assigning each entering minority a faculty advisor before the student arrives on campus. This is to assure that students receive proper guidance from the beginning of their programs.

Teaching and Research Assistantships. The Associate Provost has asked that each minority student have a teaching and research assistantship during his/her tenure as a graduate student.

Recruiting Coordination. A Committee on Recruitment and Issues of Minority Affairs was formed to coordinate recruitment across the institution. Also a committee of graduate students is being formed to advise the administration on recruiting and to help host pre-orientation for graduate students.

Workshops on Humanities and Social Sciences. Regular meetings of graduate students and faculty are held where students make presentations of their research work.

Coordinating Council for Minority Issues. A group of administrators has been charged with enhancing the minority experience at Chicago and involving the larger Chicago minority community in University activities.

University of Colorado at Boulder

Summer Minority Access to Research Training (SMART). The SMART program is a ten-week program in research and creative work for minority undergraduates from around the country. Each intern conducts a research project with a faculty mentor, earns five hours of upper-division credit, and learns about the opportunities afforded by a graduate education. The purpose of SMART is to interest minority students in attending graduate school.

Patricia Roberts Harris (PRH) Fellowship Program. Funded by the Department of Education, the PRH program provides 3-year fellowships for beginning graduate students in selected disciplines. The PRH fellows receive social support and academic guidance, as well as financial support. The SMART program provides a pool of students from which to recruit PRH fellows.

Publications. The Graduate School publishes a minority brochure outlining the programs and opportunities for minority graduate students on the Boulder campus. The brochure is published in both English and Spanish. In addition, information on national minority programs and a brochure explaining the SMART program are distributed nationwide to colleges.

Targeted Minority Network. This effort enlists faculty members to visit institutions with high percentages of minority undergraduates for the purpose of recruiting minority students for graduate study. The faculty members talk to students, faculty, and staff in many academic areas about graduate studies at the University of Colorado at Boulder and special programs offered for protected class students.

Minority Advisory Council. The Council, composed of minority members of the Boulder-Denver community, provides social activities and career networking for minority graduate students and acts as a support group for SMART interns. It also provides ongoing information and counsel about ethnic minority communities for the Graduate School.

University of Illinois at Chicago

Community College Articulation. The University of Illinois at Chicago/Chicago City Colleges (UIC/CCC) Partnership Program creates a relationship through which cohorts of community college students are identified who may be eligible to go on to the University. The Graduate College sponsors a summer research program for students who are in the process of transferring to the University. This program serves to enhance the students' transition to the four-year institution, as well as to encourage their application to graduate school.

Graduate College Relationship with Undergraduate Support Services. Efforts are under way to review current student support services to identify whether weak areas exist and to suggest ways to strengthen that support.

Increase Minority Faculty. In 1985, a concerted effort was made to increase minority faculty. A pool of resources was created to provide colleges with matching funds for salary, as well as equipment and research support for the recruitment of African American and Hispanic faculty. In the first year, 34 African Americans and Hispanics joined the faculty. Additional signing brought the year's total to 39: 24 tenure-track and tenured African American faculty and 15 tenure-track and tenured Hispanic faculty. The campus now has hiring goals for specific units, which were set by the chancellor for the first time in 1990.

Faculty Support. Campus leadership is also exploring a faculty-staff fellowship opportunity to encourage master's degree level minority faculty and staff to pursue Ph.D. degrees.

Faculty Research in Minority Areas. The Task Force on Retention of Minority Graduate Students raised several questions regarding the retention of all graduate students, and was the catalyst for the Dean of the Graduate College to encourage faculty research in the area of graduate student retention. Currently, a faculty member in the College of Education is administering the first stage of a longitudinal study of newly entering graduate students to assess strengths and weaknesses of graduate programs and to determine why students do or do not complete programs of study. The ultimate goal is to improve services and the quality of graduate education so that more students reach their educational objectives.

University of Illinois at Urbana-Champaign

Summer Research Opportunity Program. This program has been in existence for about four years. In 1989–90, the program involved 72 student participants and 65 faculty. This program provides one of the best ways to build the sensitivity and involvement of faculty. Costs for the programs are shared by the Office of Graduate Studies, the departments, and the Chancellor.

Recruitment. A letter is sent to faculty asking them to identify the best undergraduate students and to talk to them about considering graduate studies. Included with the letter is information on national and campus fellowships. In addition, a letter is sent to the presidents of all student honor societies to encourage the organizations to have at least one meeting to discuss graduate education and to provide names of faculty contacts in various disciplines.

Minority Academic Partnership Program. Undergraduate minority students from the University of Illinois who decide to pursue academic careers and are admitted to graduate study receive financial support for their graduate programs at the University of Illinois from the departments and the university.

University of Kansas

Summer Research Program. This program has been ongoing for several years. In 1990, 26 minority students, in a variety of fields, worked with faculty during the summer.

Faculty Programs. An all-day workshop for faculty was organized in 1990 on the topic of mentoring minority graduate students.

Student Recruitment. A conference was sponsored by the graduate school to interest students with a 3.0 GPA in graduate education. Even though the recruitment budget has been static for several years, an effort is being made to form a network of faculty members to participate in recruitment activities.

Student Retention. There is a graduate teaching assistantship program for minority students that provides central sponsorship of minority graduate students during their first and third years; departments are responsible for sponsorship during the second and fourth years and until the student graduates, assuming that the student continues to make satisfactory progress toward a degree.

University of Michigan

Recruitment. Approximately $20,000 is expended each year to support recruiting trips to recruitment fairs at historically black institutions and predominantly Hispanic institutions. The graduate dean's office also assists in coordinating departmental recruitment trips. A computerized system and 800 telephone number are used to follow up on the contacts made and to establish a list of contacts in the computer admissions database.

Summer Research Opportunity Program. This program also serves an important recruitment service. During summer 1990, approximately 70 sophomores and juniors

participated, 25 from historically black and traditionally Hispanic institutions. Many of these students will later attend the university. These funds also support student organizations, specialized recruitment efforts such as organized recruitment weekends and travel to campuses of prospective graduate students.

Fellowships. The number of entering historically underrepresented students in the Rackham Merit Fellowship program increased from 26 in 1986 to 170 in 1990. These students are funded as part of a budget of approximately $6.5 million that supports more than 600 students. Minority students are guaranteed research positions for the remaining terms of support needed. Students are encouraged to seek, and are aided in applying for, outside support from organizations such as the National Science Foundation and the National Research Council.

Summer Research Program. Every minority doctoral student is offered an opportunity to enter the university during the summer prior to starting graduate study. Three summer graduate programs in the natural and biological sciences, humanities, and social sciences facilitate the building of networks for the student in his/her discipline. In some cases where the summer program focuses on preparing for language and statistical methodology requirements, it may reduce the time taken to complete the degree.

Faculty Support Programs. The Minority Faculty Development Fund is designed to assist junior faculty in achieving tenure. In cooperation with academic units, this program provides funds to cover travel, release time, and funding for research, and graduate student support for minority faculty.

Target of Opportunity Program. This program is funded by each department giving back a small percentage of its operating budget to a central university pool. When the department makes a "Target of Opportunity" appointment, that is, proposes to hire a minority faculty member outside of the regular department personnel budget, an incremental position is given to the department for that position.

Improving the Environment of Graduate Students. Special colloquia are held to promote an understanding and awareness of the intellectual achievements of minority students.

Graduate School Interaction with Departments. Members of the dean's staff hold GRE workshops and discuss admission requirements with departments and make departmental visits to discuss how units might be more inclusive in their admission of minority students.

Contractual Arrangements with Sophomores. A special pilot project with two state universities has been established. Minority sophomore students participating in the Summer Research Opportunity Program can make contractual agreements with the university to receive four years' graduate financial support if they are accepted in an appropriate graduate program.

University of Mississippi

Minority Graduate Funds and Minority Enrollment Increases. During the period 1988–90, without changing admissions requirements, the university increased its minority graduate enrollment from 1% to 17%. Funds to support this activity rose from $19,000 to $1.2 million.

Racial Awareness. University 100, an introduction to the University, required of all entering freshmen, includes segments on racial awareness. Discussions of racial awareness are also being included in the week-long orientation for graduate student assistants.

Liaison with Black Colleges. Contact has been made with about 40 historically black colleges. There are two or three visits a year to those institutions and, in addition, their students and faculty are brought to the campus for a spring conference that is fully funded by the university. The university also plans to invite faculty from the historically black institutions to teach summer courses while many of the regular faculty are on vacation or not teaching.

Financial Assistance. Minority students are guaranteed free tuition and receive a stipend if they are enrolled full time.

Summer Minority Participation Program. Junior-level students participate in this program and at least 50% of them go on to graduate school.

Graduate Dean's Intervention. The graduate dean will intercede with departments on behalf of minority students who meet the admission standards.

University of South Carolina

In 1990, 8 percent of all graduate degrees (157/1,965) and 5.5 percent of doctoral degrees (14/252) were awarded to black students. The University has developed several programs to increase the number of minority students in graduate school.

Graduate Student Fellowship Program. Each year, this program awards 10–15 fellowships to minority doctoral students. These awards are made on a competitive basis and provide $10,000 per year for a maximum of four years.

Other Fellowship Programs. The university participates in programs similar to those at other institutions, including The Ronald McNair Summer Science Program and The Patricia Roberts Harris Program.

Undergraduate Recruitment and Retention. University faculty regularly visit high schools to encourage minority students to pursue advanced degrees. This effort has resulted in increasing the number of black students entering the sciences. During the last year, one in five of the new undergraduate science students was black.

The University of South Carolina also has an excellent record of undergraduate student retention. "University 101" is a 3-credit course offered primarily to freshmen students. It is aimed at retention and provides entering students with an introduction to the university. This course has helped to increase the number of minority student graduates, and many institutions across the country have developed similar approaches.

The University of Texas at Austin

Graduate Opportunity Program. This three-person unit is the minority affairs office of the Graduate School at The University of Texas at Austin. A full complement of recruitment, professional and academic development activities and graduate fellowships are offered to master's and doctoral minority students.

Recognizing that The University has one of the largest undergraduate black and Hispanic enrollments, a recent emphasis has been to expose these promising minority students to the potential offered them by graduate education. This is accomplished in many ways, among them summer research experiences, presentations to minority undergraduate organizations, and several new programs such as the following.

The Honor Roll Reception. This reception for minority juniors and seniors is a cooperative venture between the Graduate School and the division of Student Affairs. The annual event provides an opportunity for faculty members to speak one-on-one with undergraduates about graduate school. The initial letter of invitation is mailed to the student's parents and is signed by the Graduate Dean. In the letter the Dean communicates his positive assessment of the student's academic abilities and encourages the parents to discuss their child's interest in advanced studies.

The Minority Scholars Forums. These Forums, an outgrowth of the Danforth Compton Fellowship Program, provide advanced minority doctoral students with an opportunity to present their research to an interdisciplinary audience. Using their majors and performance records as criteria, selected minority undergraduates are invited to attend the forums. An informal reception follows the academic presentations and helps create a comfortable setting for undergraduates to meet graduate students and discuss future academic plans.

University of Washington

Budget. The Office of the Graduate Dean has been successful in getting budgetary support for graduate students both from internal and external sources. Among other sources, the university currently receives $150,000 for minority recruitment from the Danforth Foundation.

Solicitation of Faculty Participation. The results of efforts to involve faculty have been mixed, depending primarily on the interests and support of the deans of the colleges. The College of Engineering has been particularly successful in encouraging faculty participation. The areas of social work and public affairs have also been successful in gaining faculty involvement. The professional organization within the political science department has made recruitment of minority graduate students a top priority. Efforts are being made to consolidate recruitment throughout the University.

Other Activities. The Provost regularly holds departmental meetings on recruitment with the faculty. Cultural Diversity Sensitivity Sessions for the President's Cabinet

have been initiated, and this effort has been extended to other campus administrators. An African American Graduate Student Seminar Program has recently been developed. A new student mentoring program is planned for the next academic year.

University of Wisconsin-Milwaukee

Institute on Race and Ethnicity. The Institute, which is system-wide, will fund grants for research to help ethnic minority faculty prepare for tenure. The institute has provided support to develop 21 new courses on ethnicity. It sponsors colloquia and roundtable discussions and publishes books on race and ethnicity.

Minority Scholars Program "Forgivable Loans." This program will offer forgivable loans to minority graduate students who will consider employment in a faculty position at Wisconsin upon the completion of their Ph.D. degrees. The program will provide support of $10,000 per academic year and $2,000 in the summer.

Explore the Future Program. In conjunction with other universities, a spring program is held for minority students that explores the feasibility of pursuing a graduate degree.

Collaborative Programs. There has been a collaborative program with Florida A&M University for about five years. Similarly, the Department of Defense is supporting activities that bring faculty and students together from two other historically black institutions and the University of Wisconsin-Milwaukee.

Urban Research Center. The Research Center is gathering information on pipeline issues in a continuing research project.

Center for Math, Science Education. Efforts are being made to work with the school system on retraining high school mathematics teachers and improving the mathematics skills of students in the 6th through 12th grades.

Washington University

The institution has made a commitment to a number of large-scale efforts to socialize and integrate students of color into the university. Faculty mentoring is considered one of the most successful activities for this purpose. Recently, faculty recruitment efforts have been enhanced by incentives provided through the Central Administration which emphasizes that minority faculty recruitment has a very high priority. In addition, the Minority Undergraduate Scholarship Program has been in place for some time. The success of this program is made possible by a sizeable budget and strong institutional commitment.

Mr. and Mrs. Spencer T. Olin Graduate Fellowship Program for Women. This is a university-wide blue ribbon fellowship program that includes an annual conference, panel discussions, and networking within the university. The conference, which is put on by the students, has featured noted speakers such as Johnetta Cole, President of Spelman College, and Supreme Court Justice Sandra Day O'Connor, who discuss topics of interest to the Fellows and the campus community.

Chancellor's Graduate Fellowship Program for African Americans. This is a new program patterned after the Fellowship Program for Women. It will provide five years' support (a twelve-month period is supported by full-tuition scholarship plus a combination of stipend and educational allowance making up no less than $15,000). Each year six or seven new students are to be selected for the program which will have a steady-state total of 30 or 40 participants.

Yale University

Undergraduate Level Programs. Yale has instituted a number of events and programs to identify and motivate minority students at the undergraduate level. In 1990 a summer research program was instituted. This program, named for Edward Bouchet, the first black student to graduate with a Ph.D. from Yale, is designed to expose students who have experienced difficulty in advancing through the educational programs to available resources and support services at the university. Information sessions are held with students who are considering proceeding on to graduate education. In collaboration with Yale College, the graduate school has participated in a number of summer programs to interest students in graduate education. In addition, twelve undergraduate colleges have appointed math, science and writing tutors. There is also a formal mentoring program where freshman and sophomore students are allied with a graduate student or a senior undergraduate to give them assistance.

Graduate Level Programs. Programs at the graduate level have been aimed at recruitment, retention and facilitation. Dissertation Year Fellowships have been instituted for students in the humanities and social sciences. Also available to students are Danforth-Compton and Patricia Roberts Harris fellowships. In addition, graduate students are made aware of national awards (NSF, NIH, etc.) and encouraged to apply.

Conclusion

In this booklet we have described some of the activities undertaken during the past few years to increase minority participation in graduate education. In all of these activities, the graduate school is uniquely situated to play an important role. By virtue of its interactions with many departments and, in some cases, colleges, the graduate school has the ability to develop campus-wide programs and to provide connections between and among units so that individuals from a variety of disciplines and departments can exchange views, help resolve problems, and share successes. This ability to work across the campus is especially valuable in developing and maintaining a minority presence in the university since the issues involved are not limited to any particular unit or discipline. In fact, many of our discussions suggested the need to extend the boundaries of the institution to all parts of the educational system as we address the problems of adequate preparation for graduate students.

In taking a campus-wide view, graduate deans can utilize the talents of a growing number of faculty, administrators, and students, of diverse backgrounds and cultures, who are committed to the idea of a culturally diverse academic community that fosters intellectual excellence. In much the same way that graduate school funds provide leverage through which the graduate school can obtain departmental commitment for the financial support of minority students, a group of dedicated faculty, willing to share their time, enthusiasm, and experience, can provide leverage with their colleagues to obtain greater participation of faculty working with minority students.

Three years ago, in the first set of meetings on this topic, frustration was expressed on the part of many deans with respect to their ability to influence faculty and institutional attitudes toward the increased participation of minorities in graduate education. During the intervening years, however, that mood has changed to one of cautious, but real optimism. We heard again and again how faculty, given the opportunity to work with minority students in a variety of early identification programs, become advocates for such programs and seek out these students. We also heard that while the moral, social, and legal imperatives to increase minority graduate enrollment and degree attainment are compelling, the factor that seemed to have the greatest impact on faculty behavior was the recognition that minority students constituted a heretofore underutilized source of capable and productive colleagues. It is this recognition, on intellectual and professional grounds, that will provide the basis for the continuing commitment of universities to increase the participation of minorities in graduate education.

CGS Idea Exchange Winter Meetings 1990–91 Participants

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Also in attendance were: Sarita E. Brown (Univ. of Texas at Austin), John B. Turner (Knoxville College), Leonard A. Valverde (Univ. of Texas at San Antonio) who acted as discussion facilitators, Jules B. LaPidus (CGS), Thomas J. Linney, Jr. (CGS), Peter D. Syverson (CGS), Mark Clark (CGS), and Deanna E. Falge (U.C. Davis).

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SUMMER
MEETING
1991

ENHANCING THE MINORITY PRESENCE IN GRADUATE EDUCATION III: INSTITUTIONAL PARTNERSHIP PROGRAMS

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ENHANCING THE MINORITY PRESENCE IN GRADUATE EDUCATION III: INSTITUTIONAL PARTNERSHIP PROGRAMS

COUNCIL OF GRADUATE SCHOOLS

With Support From The Ford Foundation and
The Carnegie Corporation of New York

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Foreword

In a series of meetings called "Idea Exchanges," CGS has been exploring various approaches to enhancing minority participation in graduate education. This volume represents the outcome of one such meeting, and provides an in-depth look at several types of institutional partnership programs involving universities, corporations, or research laboratories that are designed to encourage minority students to go on to graduate school.

Much of the general narrative in this document was adapted from an essay by Clara Sue Kidwell, Associate Professor in the Native American Studies Department at the University of California at Berkeley and former Dean in Residence at CGS, entitled "Minority Progress Through the Educational Pipeline." Kay Hancock, Information Officer at Vanderbilt University, served as editorial consultant and prepared the first draft of the document.

Special thanks are due to Mark Clark, CGS Dean in Residence for 1990–91, who organized the meeting, and to Leslie McLemore, Chair of the CGS Advisory Committee on Minority Issues in Graduate Education, who chaired the meeting.

We gratefully acknowledge the generous support provided by The Ford Foundation and The Carnegie Corporation of New York that made this project possible.

Jules B. LaPidus
President
Council of Graduate Schools
March 1992

Introduction

Given the projected rate of faculty retirements through the 1990s and the shrinking of the college age population cohort, many educators are concerned about the need to provide new faculty for America's colleges and universities. Since faculty positions will continue to require graduate education at least through the doctoral degree, the concern extends to the pool of potential students available to fill the pipeline to doctoral degrees. By the year 2000, the 20–25 year age group, from which graduate students traditionally have been drawn, will be approximately 20 percent smaller than it was in 1980. It also will be made up of a much larger percentage of people of African American, Hispanic, Asian, and Native American origin. A significant proportion of the Hispanic and Asian populations will be immigrants whose native language is not English. Thus the traditional pool of potential graduate students is growing simultaneously smaller and more diverse and will be composed increasingly of individuals from groups that have been underrepresented in graduate education. That creates two options for increasing the number of people entering doctoral studies: one is to expand the pool to include older students, perhaps those who have been out of school for some time; the other is to increase the percentage of those students in the traditional pool who go to graduate school. Since the percentage of baccalaureates who go on to doctoral study is quite small, even large decreases in the total pool need not lead to decreases in the number of those electing this path. The key is increasing the yield; making more options available to undergraduates and convincing more of them to go on.

Coupled with the changing demographics of American society is a growing concern for American competitiveness in international markets. American students are not entering Ph.D. programs in science and engineering in sufficient numbers to maintain the technological lead that has undergirded the country's strength in the world economy.[1] The percentage of Ph.D.s in the physical sciences and engineering granted to American citizens shows a significant decline between 1970 and 1990—from 83.3% to 60.5% in the physical sciences, and from 73.6% to 42.9% in engineering.[2] The pool from which graduate education in the sciences draws appears to be drying up.

In 1990 minorities earned 9.4% of all doctorates awarded to U.S. citizens. The underrepresentation of members of American minorities in graduate education is due to a large extent to their attrition at various stages of the educational process and to qualified minority students choosing options other than graduate school. What-

[1]Erich Bloch, *Basic Research: The Key to Economic Competitiveness*. Washington, D.C.: National Science Foundation, 1986; Government-University-Industry Roundtable, *Nurturing Science and Engineering Talent*. Washington, D.C.: National Academy Press, 1987; U.S. Congress, Office of Technology Assessment. *Educating Scientists and Engineers: Grade School to Grad School* OTA-SET-377. Washington, D.C.: Government Printing Office, June 1988.

[2]*Summary Report 1990: Doctorate Recipients from United States Universities*. Washington, D.C.: National Academy Press, 1990, 10.

ever the reasons, to ensure the health of U.S. education at all levels, indeed the health of our society, the pool of minority students participating in graduate education must be expanded.

Demographic trends are subject to change through intervention. To encourage greater minority participation in graduate education, universities can do more than simply wait at the end of the pipeline for the trickle of minority students to come through. "Early identification" is a viable approach to recruitment; the premise is that students can be encouraged to pursue graduate study if their talent is identified at an early stage in their college careers and nurtured throughout the undergraduate years.

By ensuring that students who have the potential for graduate work have every opportunity possible to develop that potential and by planning for a smooth transition from undergraduate to graduate study, the "early identification" approach facilitates greater and more successful participation of students in graduate education. Early identification and careful preparation not only enhance recruitment of minority students but help forestall situations in which a minority student in need of remediation is admitted to a graduate program and then stigmatized as either an "affirmative action" or "unqualified" admit.

Institutional partnership programs provide one means by which talented minority students can be identified at an early point in their undergraduate careers and prepared to attend graduate school. Graduate deans may find the institutional partnership model especially appropriate for their participation. As senior administrators in their institutions, they can initiate with other institutions cooperative efforts that are designed to attract minority students into the graduate school pipeline.

Pipeline Transitions

Two-Year/Four-Year Transfer

Two major transitions occur in the pipeline at the college level. One is the transition from a two-year college to a four-year institution; the other is the transition from undergraduate to graduate education. Although none of the consortial or partnership arrangements discussed in this document focus on the first transition, it is a critical juncture for minority students and will be discussed briefly here.

Graduate deans can acquaint themselves with the relationship between two-year colleges and four-year institutions and find out what their own institutions are doing to promote articulation and transfer. Minorities are concentrated in two-year colleges, and their rate of transfer from those institutions to four-year programs is thought to be quite low.[3] A short monograph published by the American Association of Community and Junior Colleges describes three types of statewide articulation and/or transfer agreements: formal and legally-based policies (Florida and Illinois); state system policies (North Carolina, Washington, and Maryland) and voluntary agreements between individual institutions or systems (California and Michigan).[4]

Deans can look for two-year colleges that are making an effort to improve the transfer rate for students, especially for minority students, and invite faculty from those institutions to engage in discussions with faculty on their campuses. The Ford Foundation has developed an Urban Community College Transfer Opportunities Program aimed at strengthening the community college transfer function. In one part of the project, five community colleges in urban areas with significant minority populations have been funded to develop articulation agreements, to identify factors involved in student decisions to transfer or not, and to provide better services to students who wish to transfer.[5]

Another study funded by The Ford Foundation is of the articulation and transfer process between four American community colleges and four state universities. The study utilizes an ethnographic approach to discover the factors that impede or promote the transfer of American students from community colleges to four-year institutions and the factors involved in the success or failure of students who do transfer.

More recently, in 1989, The Ford Foundation provided funds for the establishment of The National Center for Academic Achievement and Transfer, under the auspices of the American Council on Education. The purpose of the center is to strengthen the

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[3]Reginald Wilson and Deborah J. Carter, *Minorities in Higher Education: Seventh Annual Status Report 1988* (Washington: American Council on Education, 1988), 1; James R. Mingle, *Focus on Minorities: Trends in Higher Education Participation and Success* (Denver: Education Commission of the States and the State Higher Education Executive Officers, July 1987), 20–21; Shirley Vining Brown, *Minorities in the Graduate Education Pipeline*. Princeton: Educational Testing Service, 1987, 4–6.

[4]Frederick C. Kintzer and James L. Wattenbarger, *The Articulation/Transfer Phenomenon: Patterns and Directions* (Washington, D.C.: American Association of Community and Junior Colleges, 1985), 22.

[5]Ford Foundation, *New Initiatives for Transfer Students* (New York: Ford Foundation, 1984).

transfer relationship between community colleges and four-year institutions, especially for low-income black and Hispanic students. Its primary goal is to increase the numbers of students who transfer and achieve baccalaureate degrees.[6]

Cooperative agreements between institutions can give students a realistic sense of how they can use their community college courses in a four-year program. Graduate deans can inform community college students of graduate school requirements so that they can see how their undergraduate preparation relates to preparation for graduate school. Conversations between graduate deans and community college faculty and administrators also can explore the factors affecting minority student attendance in junior college and how they view these colleges in terms of preparation for further higher education or as means to gain specific job skills. Community college faculty can encourage students to consider graduate school, particularly if these faculty members are considered as a resource for the early identification of talented students.

Laying the Groundwork for Institutional Cooperation

How can institutions that differ widely in scope and resources work together to promote the early identification of talented minority undergraduates and to assure that they are recruited by and accepted into appropriate graduate programs? Institutions entering into cooperative agreements for the purpose of encouraging minority participation in graduate education must establish a formal structure that will promote full understanding of the strengths and weaknesses of the student's undergraduate preparation vis à vis the demands of the research institution. Defining the expectations of the cooperating institutions about what each can contribute to the partnership is a major issue.

Organizational issues also arise in establishing cooperative agreements between and among institutions. Central administrative responsibility, staff time, incentives for the institutions to participate, and a financial commitment by one or more of the participants, or an external agency, are essential ingredients in all interinstitutional arrangements. All of these issues are illustrated and discussed in this document. The emphasis, in all cases, is on exploring how things really work, the pitfalls to avoid, and the factors that seem to be associated with success.

Institutional partnership programs can help to increase the flow of minority students through the educational pipeline. Provosts, college deans and graduate deans can play an important role in the development of that pipeline. In their role as institutional leaders, they can influence the commitment of resources to the development of cooperative programs; they can take a leadership role in encouraging faculty members to identify talented students; finally, their offices can serve as the formal links between institutions.

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[6]*Setting The National Agenda: Academic Achievement and Transfer* (Washington, D.C.: American Council on Education, 1991).

CGS Institutional Partnerships Project

The Council of Graduate Schools' (CGS) Institutional Partnerships Project had its origins in discussions of the CGS Minority Advisory Committee on Graduate Education. In June 1991 the CGS brought together in Washington, D.C., representatives from eight partnerships, alliances, and consortia that have been created to increase the number of students from underrepresented minority groups who will attend graduate school and enter careers in teaching and research. Representatives from each program discussed the background, nature, and workings of their program, as well as its strengths and weaknesses. In all cases, an attempt was made to reflect on what lessons had been learned in the course of initiating and developing the program. It is important to recognize that the partnerships described were initiated at different times and thus represent different stages of development. A synthesis of those presentations, and the written reports and group discussions that accompanied them appear here to serve as an information source and a guide to institutions contemplating cooperative ventures designed to bring more minority students into graduate education. Four categories encompassed the institutional partnership programs discussed at the June meeting: (1) institutions and consortia, (2) institutions and corporations, (3) institutions and national laboratories, and (4) institution-institution agreements.

Institutions and Consortia

CIC Alliance for Success

The Alliance for success is a consortium of 14 major research institutions that make up the Committee on Institutional Cooperation (CIC)[7] and six Historically Black Colleges and Universities (HBCUs).[8] Established in 1986, the Alliance is a comprehensive, cooperative effort to increase the numbers of minority faculty members nationally. The Alliance programs and initiatives are designed to affect the pipeline at several critical stages from pre-college through graduate research.

The Summer Research Opportunity Program (SROP), which has been in effect since 1986, is the cornerstone of the Alliance. It provides minority sophomore and junior undergraduates, in all disciplines, with a research experience for an eight- to ten-week period during the summer. During the program, students engage in research with a faculty mentor and/or research team; acquire information about graduate school and financial aid; develop verbal and written communication skills; and gain self-confidence. Since 1986, more than 2,000 students have participated in the SROP, and more than two-thirds of the graduates are now in graduate or professional school.

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[7]The University of Chicago, University of Illinois at Chicago, University of Illinois at Urbana-Champaign, The University of Iowa, University of Michigan, University of Minnesota, University of Wisconsin-Madison, University of Wisconsin-Milwaukee, Indiana University, Michigan State University, Northwestern University, The Ohio State University, The Pennsylvania State University, Purdue University.

[8]Coppin State College, Jackson State University, Lincoln University, Prairie View A&M University, Texas Southern University, Xavier University of Louisiana.

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Future Alliance plans include implementation of the following initiatives:

- Coordination of Pre-College Programs to enhance recruiting efforts directed at increasing minority student participation in higher education. The thrust of this initiative is information-gathering: bringing together people who run the programs, developing an inventory of all the pre-college programs on Alliance campuses, compiling a database of students who are participants in those programs so that they can be recruited to any of the 20 Alliance campuses.
- Curricular Enhancement and Enrichment to develop and implement pedagogical changes that will augment retention and advancement of targeted student groups.
- Summer Freshman Institutes for undergraduates to provide nurturing and academic stimulation, enhancement of problem-solving and critical thinking skills, as well as preparation for the SROP research experience. These institutes will occur at the end of the first year.
- Academic Year Programs to extend the SROP experience by offering independent study or teaching opportunities so that students can continue their summer research during the academic year. About half of the SROP participants say that they continue their research after they return to their home campuses; Academic Year Programs seeks to expand that number by providing a variety of ongoing research experiences.
- Graduate Student Support Programs to provide minority students with the financial and academic support essential to their successful completion of graduate study and the pursuit of faculty careers. CIC already has fellowship programs for minorities in the social sciences and humanities, and has recently received support for students in sciences and engineering, which will be directed toward students who have participated in the SROP and then are accepted by one of the CIC graduate schools.
- Faculty Development and Interchange Programs to facilitate interaction and cooperation among faculty on individual campuses as well as across institutions. These Alliance programs will entail research enhancement seminars and workshops, short- and long-term faculty exchanges, joint and visiting faculty appointments, collaborative research activities, and other opportunities to expand faculty participation in Alliance programs.

The Alliance is asking member colleges and universities to cooperate in a very competitive environment and to compete in a cooperative environment. Chief academic officers at the participating institutions provide the overall governance for the Alliance, but their key role is to work within their institutions to ensure that the mechanisms are in place to involve faculty and staff and students on their campuses in Alliance programs.

Chief academic officers appoint members of the Alliance's steering committee which is responsible for setting the Alliance's policy and priorities, reviewing and evaluating all of the group's programs, fostering new initiatives, and providing mechanisms

for sharing information—a critical need in a group of this size. Each steering committee member chairs an Alliance Advisory Committee on his or her campus, and that committee consists of faculty and staff members who are participants in the Alliance programs described above.

The Undergraduate Institution. To ensure the success of minority undergraduates in the Alliance's Summer Research Opportunities Program, the undergraduate institutions must carefully select SROP participants and provide them with adequate research experiences prior to the SROP. At one of the undergraduate institutions (Coppin State College), most of the SROP participants were either Ronald E. McNair Postbaccalaureate Achievement Students or in the Honors Program. Department chairs nominate other students for SROP. The college requires students to participate in academic year roundtables that anticipate the SROP experience, and the McNair Program requires its students to participate in research projects during the academic year. Additionally, the McNair Program conducts an orientation for participants that is led by former SROP participants. To motivate other students to aspire to summer placements, the McNair Program hosts a reception honoring summer research participants.

For students at Coppin State College, the SROP enables them to win places in graduate programs at major research universities. Two Coppin students have begun graduate studies at the same institutions—the University of Illinois at Urbana-Champaign and the University of Wisconsin-Madison—where they engaged in summer research. Without the summer experiences, both students have said that they would not have considered those universities and probably would not have gone on to graduate school.

Weak links in the program from the perspective of the undergraduates' home institutions are the following:

(1) Relatively late identification of summer mentors and research projects prevents students from exploring the subject in advance and developing ties with their mentors before going to the summer research sites; it also makes it difficult for the summer mentor and the academic year mentor to establish a relationship that would enhance the student's research experience.

(2) The students' undergraduate institutions receive a paucity of information about the identities of the students' summer mentors or aspects of their summer experience while the students are engaged in their summer research experiences. To keep informed, Coppin State College has designed a form for their students to complete and return after they arrive at their summer sites.

(3) Lack of timely feedback from summer mentors inhibits the support that students' undergraduate institutions can provide. Coppin State College has developed a feedback form for mentors, which they ask their students to ensure that the mentors complete and return. When the director of the Alliance for Success program at the undergraduate institution receives a response from the student's summer mentor at least by late August, the director can address the mentor's concerns with the student early in the fall semester.

(4) No mechanism now exists for students to continue their summer research projects once they return to their home institutions. A major task ahead for the SROP is to create a real bridge between the students' summer and academic year experiences, thereby strengthening the SROP as the cornerstone of the Alliance.

The Major Research University. Applications for the SROP are collected in the CIC office and sent to CIC institutions for review. A major research institution, like the University of Illinois, Urbana-Champaign, will select students whom they can place with appropriate mentors and support financially. Because funding comes from a number of sources, a research university is not always able to select every student interested in participating in its program. The SROP at the University of Illinois began with ten students in 1986 and had grown to 89 by the summer of 1991.

To ensure institutional commitment to the SROP, the Graduate School at the University of Illinois at Urbana-Champaign has an advisory committee composed of an associate or an assistant dean of each of the undergraduate colleges. Applications from Alliance students are sent to the major colleges, which then identify a department head or faculty member who will suggest appropriate placements. This decentralized placement process allows each of the colleges to claim ownership of the program and remain committed to it. Another mechanism for reinforcing a sense of ownership of the program is that each college makes a financial contribution to the support of SROP students.

Once summer placements are found for students, the Alliance office at the host university gets in touch with the student directly about the research he or she will be doing. Because of the complexities of the process, placements can be late. When students arrive on campus, however, they begin to relate to a mentor, and the faculty members involved become interested in these students and their welfare.

Problems perceived by a host research university include how to maintain quality when there is pressure to increase the number of participants; how to maintain institutional commitment in tight budgetary times; and how to continue to involve the colleges, e.g., in the teaching of mini-courses, without overworking the students.

Funding. The major research universities participating in the Alliance for Success provide the bulk of financial support for it. Some support from the federal government comes from Title IX grants, the McNair Achievement Program, and the U.S. Department of Agriculture. The Mellon and Lilly Foundations have given grants to the Alliance, and it has used that money as leverage to have the institutions contribute additional funds.

Lessons Learned. Several issues are of concern to the Alliance:

(1) Long-term effect. It is essential to transform the culture of campuses so that programs like these are viewed as part of the way universities work, rather than as extraordinary or one-time activities. The Alliance has brought together faculty members in mathematics and chemistry to talk about what they can do within their disciplines to start transforming the curriculum so that they can better attract and retain students in those fields and in the sciences and engineering. Similar efforts will be made across the disciplines.

(2) Sustaining the institutional commitment of faculty and staff members who contribute their time and energy. Institutions participating in the Alliance for Success need to find ways to recognize and reward faculty members so that they will continue to participate. To encourage continued faculty participation, the programs must become an integral part of the faculty members' activities and not be viewed as an add-on.

(3) Bringing new personnel up to speed. Chief academic officers and members of the steering committee change every year. A mechanism is needed to bring all of the participants together so that seasoned people from other institutions can help inform and enlighten the new members of the committee. The Alliance also conducts continuous ongoing evaluations of its programs so that they can report on the successes and deal with the weaknesses.

(4) Sustaining financial support. Grant-writing consumes a major portion of the director's time. The agendas of the funding agencies and the Alliance for Success may differ slightly, so the challenge is to balance the funding agency's interests with the Alliance's goals and meld them. The member institutions now are paying 60 percent of the cost for the SROP, thereby making them a funding agency. The Alliance must be responsive to the institutions' interests and concerns yet be sufficiently focused to ensure that everyone is headed in the same direction.

(5) With 20 institutions and a wide variety of faculty, staff, and students, many opportunities exist to make things happen. The large size of the Alliance can, however, create an administrative nightmare; the complexity of pulling all the components together requires a great deal of attention.

(6) Communication and coordination issues. It is easier to generate cooperation across the campuses than within an individual campus. Working with faculty members within the disciplinary areas will help engender that intra-institutional awareness and cooperation.

The Consortium for Minorities in Teaching Careers

Increasing the number of minority teachers for a growing minority school population is a national concern underlying the creation in 1989 of a Consortium for Minorities in Teaching Careers. This Consortium brings together, for the first time, two- and four-year colleges, research institutions, historically black colleges and universities (HBCUs), and predominantly Hispanic institutions (PHIs). The ten cooperating institutions[4] have signed a formal Memorandum of Understanding and Intent to develop, over the next ten years, a comprehensive national model to increase the number and enhance the preparation of minority teachers.

Together these varied institutions can address needs and develop programs that complement each other at all levels of the pipeline, from college-based pre-college

[4]California State University, Dominguez Hills; The City College of New York; Fordham University; Eugenio Maria de Hostos Community College, New York; University of Iowa; Knoxville College, Tennessee; Metropolitan University, Puerto Rico; Morgan State University, Maryland; Turabo University, Puerto Rico; Xavier University, Louisiana.

early identification and enrichment programs, through two-year transfer programs, bachelor's degree programs, and graduate program alternatives up to the Ph.D. degree, thereby providing a continuum of programs for minority students. The proposed program is national in scope and will develop replicable models to address the needs of diverse minority populations, including bilingual models, in a variety of geographic settings across the country.

Fordham University, a member of the Consortium, already has had experience in educating doctoral students from Puerto Rico. Through a program that began in 1981 with the Ana G. Méndez Educational Foundation, 32 Puerto Rican students earned their Ph.D. degrees at Fordham. The University also has a Fellows in Teaching Program in which 40 percent of the students are minorities. Students with bachelor's degrees from liberal arts programs and excellent undergraduate GPAs can earn master's degrees in this program and become licensed teachers. Those who are admitted to the 15-month program receive full tuition plus a small stipend and medical insurance.

Finding long-range funding for the Consortium is now a priority. The Carnegie Corporation has given the Consortium a $25,000 planning grant, but funds are being sought to develop over the next decade a comprehensive national program to increase the number of minority teachers.

Institutions and Corporations

The Science and Technology Alliance

Created in 1987 by the Department of Energy (DOE), the Science and Technology Alliance includes three DOE national laboratories, three universities whose student populations are predominantly minorities, and three private corporations. Alliance members are the Fundacion Educativa Ana G. Méndez (Turabo University) in Puerto Rico, a Hispanic university; New Mexico Highlands University, a predominantly Hispanic institution; North Carolina A&T State University, an historically black university; Los Alamos National Laboratory; Sandia National Laboratories; Oak Ridge National Laboratory; and three private corporations—AT&T, Hewlett-Packard, and Martin-Marietta.

Because the Department of Energy is made up in large part of major national research centers scattered around the country, it can provide colleges, universities, and pre-college school systems with large minority populations the opportunity for their faculty members and students to interact with DOE scientists in the national laboratories. The Alliance is committed to fostering long-term relationships between the national laboratories and the participating universities.

One approach utilized by DOE is to help develop university science, engineering, and technology programs by using national laboratory staff and resources. This may involve helping universities to develop new courses and research programs, or to acquire or borrow equipment from DOE laboratories, by providing access to the laboratories' computers, or by lending scientists to the universities. A second

approach provides research opportunities and programs for faculty, students, and staff from Alliance universities at the national laboratories. The Alliance also has committed itself to aggressive pre-college programs at Alliance universities to prepare high school students for college-level study.

Each of the partnership institutions came into the Alliance with a certain set of needs. Oak Ridge National Laboratory has been able to share its strength in advanced materials research to help North Carolina A&T develop a new research capability in that area. Approximately a million dollars of computer equipment donated by AT&T leveraged another $1.8 million from Digital Corporation to provide additional computer and equipment support. Money from DOE or one of the industries involved often can be used as leverage to get additional financial support from another source for a minority institution.

The Alliance has helped New Mexico Highlands University (NMHU) win accreditation for its Engineering and Computer Technology program. Los Alamos National Laboratory provided technical assistance to the Department of Engineering Technology by developing teaching laboratories and laboratory curricula, as well as a variety of other support services. Sandia National Laboratories (SNL) assigned staff to work with NMHU faculty to develop a strategic plan for the department, teach courses, and assist in the development of course curricula, the design and development of teaching laboratories, and the development of a technical library. Through the Alliance, Hewlett-Packard donated more than $150,000 worth of computer equipment for use in the engineering technology laboratories.

At Turabo University, one of the member institutions of the Fundacion Educativa Ana G. Méndez, the Alliance played a key role in the establishment of a School of Engineering. The first dean was on loan from the technical staff of Sandia National Laboratories. He helped develop the first curriculum and laid the groundwork for the creation of the School of Engineering. The current dean is also a member of the SNL technical staff and is overseeing the implementation of the first-year curriculum. AT&T contributed $175,000 worth of computer equipment for the School's engineering laboratories and lent a professional staff person to serve as a faculty member.

North Carolina A&T University advised Turabo University about curriculum development and textbook acquisitions, so the Alliance relationship is between universities as well as among universities and DOE national laboratories. The School of Engineering also implemented a strong pre-college program to attract and retain engineering students. The Alliance worked with the school to develop an important network of resource institutions that will contribute to the school, as well as to establish a long-term plan for the school and put a five-year budget in place.

Industrial participation in the Science and Technology Alliance is not just monetary. The corporations contribute scientists from their staffs to work with the deans and faculty of the three universities. They organize programs such as career days and offer guidance on opportunities in industry in order to enhance the environment of support for students.

Funding. Funding for the Science and Technology Alliance has come from DOE and the participating industries and universities.

Lessons Learned. (1) A great deal of long-term planning is necessary to nurture a productive relationship among a federal laboratory, a private laboratory, and a minority institution so that the participants provide the kind of assistance that helps rather than hinders. Paying a lot of attention in the planning stage to what the universities really needed and what the DOE laboratories could provide was essential to establishing a productive relationship.

(2) DOE and the other participants are in the Science and Technology Alliance for the long haul. To strengthen programs in science, engineering, and mathematics at these institutions and to attract additional numbers of minority students into careers in those fields, the relationship has to be built on a foundation of mutual trust and to extend over many years.

(3) Involvement at the pre-college level is important. Recruiting young people into science and engineering and retaining them in those fields must begin before the college years.

Tuskegee University-Hughes Aircraft Company

Tuskegee University is a small, private but state-related university in central Alabama. It is an historically black institution with an enrollment of 3,500, more than 1,000 of whom are in engineering and architecture. Hughes Aircraft Company, an aerospace company based in southern California, designs, develops, and manufactures state-of-the-art electronics.

Recognizing the key role played by HBCUs in the development of the minority engineering pool in the U.S., as well as their need for industrial support, research groups at Hughes have entered into several collaborative programs with HBCUs: Space and Communications Group/Morgan State; Ground Systems Group/Jackson State; and the Missile Systems Group(MSG)/Tuskegee University. Each agreement focuses on the objective of research collaboration and other contractual involvement between the parties.

Four elements make up the Missile Systems Group/Tuskegee agreement which began in 1990:

(1) Establishment of a microwave capability is the cornerstone of the agreement because both Hughes and Tuskegee recognize the need for development of radio frequency and microwave expertise at the undergraduate level. Hughes' support includes funds to purchase equipment; first-year funds of $50,000 were leveraged with Hewlett-Packard, a chief supplier of microwave equipment, to purchase some $100,000 in equipment. Hughes and Tuskegee also are collaborating in the technical support for the laboratory curriculum. Electronics engineers at Tuskegee have gone to Hughes for periods of time; the department head spent a summer with Hughes retooling in his area, RF electronics.

(2) In the Technical Assignment Program, selected microwave engineering faculty and advanced students participate in summer, sabbatical, or cooperative education assignments at the Missile Systems Group.

(3) Participation in a long-standing Hughes program, the Minority Student Support Program (MSSP), provides for placement of two freshman students each year at an MSG facility, funding to support tutoring, funding to enhance MITE (Minority Introduction to Engineering), and/or FASTREC (Freshman Accelerated Start-up Training for Retention in the Engineering Curriculum) programs. During two one-week sessions each summer, the MITE program invites 10th- and 11th-grade students to live on campus and participate in engineering orientation activities.

Elements of the Missile Systems Group/Tuskegee agreement are part of a three-year pilot program, which is intended to grow into a long-term relationship. Tuskegee hopes to establish through the collaborative arrangement a laboratory for microminiaturizing microwave circuitry. Technical collaboration between Hughes and Tuskegee is the ultimate goal. Hughes will seek to identify specific tasks on which Tuskegee can provide technical assistance in a subcontractor capacity. The last objective is for Hughes and Tuskegee to pursue joint contracts.

Lessons Learned. In programs of this type, involving cooperative development of technology, it is extremely important that issues relating to publication and patents be resolved at the very beginning.

Institutions and National Laboratories

Lawrence Berkeley Laboratory/Jackson State University/Ana G. Méndez Educational Foundation Science Consortium

When the Lawrence Berkeley Laboratory (LBL), Jackson State University (JSU) and the Ana G. Méndez Educational Foundation (AGMEF) signed a formal Memorandum of Understanding (MOU) in 1983 to establish a Science Consortium, it was the first such collaboration among an Hispanic university system, an historically black university, and a national laboratory. LBL and JSU had signed a previous MOU in 1981. Supported by the U.S. Department of Energy's University and Science Education Programs in the Office of Energy Research, the Consortium is designed to advance the science and technology programs of JSU and the University System of AGMEF.

Long-range goals of the Consortium were to expand and strengthen undergraduate and graduate academic/research training programs, increase the number of minorities entering Ph.D. science programs, expand collaborative research projects, and develop centers of scientific excellence. To accomplish these objectives, the Consortium adopted a comprehensive approach ranging from pre-college programs to faculty development.

In the pre-college area the focus is on teacher education and honor student programs. Undergraduate student development takes place through a future scientist track, honors programs collaborations, and a research semester at LBL. To foster graduate

student development, graduate assistantships and research assistance are provided. The research component of the Consortium involves collaborative LBL/JSU/AGMEF research projects, faculty-student teams research, and campus-based research. Distinguished lecture series, short courses, and an energy research conference benefit both graduate and undergraduate students. In the critical area of faculty development, the Consortium provides assistance for new Ph.D. faculty members, giving them the opportunity to initiate research activities and to work with faculty members with similar interests at other Consortium institutions. All faculty members in the sciences have an opportunity for a summer faculty appointment at LBL in order to engage in research activities in the national laboratory, and to continue that research upon returning to their respective institutions.

Benefits of the Science Consortium from the University Perspective. One benefit is the opportunity for both faculty and students to participate in collaborative projects which spin off into other kinds of research activities and initiatives. Second, the Consortium permits minorities to be exposed to an environment that demystifies research, helping them to understand that they do have the capability to engage in research. A third benefit is the cross-cultural interaction that underscores for Consortium members the richness and beauty of cultural diversity.

From the Perspective of Lawrence Berkeley Laboratory. The Science Consortium has been a model program for giving LBL access to minority students who ordinarily have not considered science and engineering careers. LBL has learned the important role of a well-articulated research agenda in institutional development. Through the Science Consortium's research agenda, JSU and AGMEF continue to grow and to develop stronger programs in their science and engineering curricula. The number of students participating in the summer and academic year research programs is relatively small compared with the number of students that benefit from stronger programs in science and engineering at their home universities. The continuing development of these programs is an advantage to all the students in those disciplines, and one that should lead to greater participation in graduate education research programs.

Milestones in the LBL/JSU/AGMEF Science Consortium are many. Among the ones with the most far-reaching ramifications was the initiation in 1989 of Summer Research Campaigns. The three Summer Research Campaigns—El Yunque Environmental Research Campaign (Puerto Rico), Toxic Metals and Organics in the Environment (Mississippi), and Microbial Environmental Restoration using Innovative Technology (MERIT) (California)—each receive funding of $75,000. Support at that level is high enough for scientists to put these projects on their career path and to have a real stake in the project's success. They devote more time and attention to the project; many meetings take place to develop the research agenda, and, in the process, the undergraduate curriculum is strengthened.

A second milestone in 1989 was the initiation of the Undergraduate to Graduate School Bridge program. Many students who earn their B.S. degrees from Jackson State University or the Ana G. Méndez Educational Foundation are very talented but

may need some time to hone their research skills before going to graduate school. The bridge program offers them an interim year of research at LBL during which they can prepare for the GREs and gain additional research experience. Through this program students are accepted into some of the top graduate schools in the country.

In 1990 a milestone was the establishment of the Five Year Plan and Implementation Plan. While the plans themselves are useful, the process through which the plans are developed is more valuable and stimulates action. Administrators in the Science Consortium's institutions do the planning and are able to identify areas where more articulation between institutions is needed.

Principal components of the Science Consortium have changed over the years. In 1983 they were M.S. and Ph.D. programs, faculty internships, joint faculty/staff appointments, student co-op programs, graduate studies, courses/mini courses/lectures and seminars, development of undergraduate research, development of academic facilities, and computer science academic program development. By 1991 the principal components had become more general: student development through research participation, pre-college outreach programs, faculty development through research and professional activities, support for collaborative and summer research, seminar/lecture/conference series, curriculum development, evaluation, and dissemination.

Keys to Successful Collaboration for Education and Research.

(1) Funding from the Department of Energy is stable and equally distributed so that each of the partners directs a major segment of the activities underway.

(2) Flexibility in the program allows the Consortium to seize opportunities to support people and projects.

(3) The institutional umbrella is important for recognition, sharing connections, and credibility. The Science Consortium gives DOE and LBL access to minority students and faculty members at JSU and AGMEF and through that affiliation DOE and LBL gain credibility.

(4) The "action committee" of coordinators meets quarterly to implement programs and resolve misunderstandings. This committee keeps the momentum and impetus alive.

(5) LBL serves as the lead institution because it has many resources and support services to lend to the overall effort.

(6) Collaborative research related to the long-term career interests of the scientists is considered important and contributes to individual and institutional development.

(7) Institutional patience involves a long-term commitment for the Consortium partners to work together and to work out differences. Everyone is getting something out of the partnership, which keeps the Consortium going.

Lessons Learned. Several factors are critical to the success of the Science Consortium. Of them the most important are (1) financial support from DOE; (2) administrative support from all three institutions; (3) inter- and intra-institutional planning (plan-

ning is a dynamic process; as environments change, the Consortium has to be able to respond to the changes); (4) evaluation; it is important to be able to document what the program has accomplished.

A remaining challenge is to broaden the base of minority students going into science and engineering careers by identifying and encouraging students who otherwise would not choose that career path.

NASA Programs

NASA's *Graduate Student Researchers Program* began in 1980. Although the program was successful, NASA was concerned that relatively few members of underrepresented minority groups were participating. Thus, in 1987, NASA introduced the *Underrepresented Minority Focus Component*. This program enlists the assistance of university principal investigators on NASA research grants in locating promising minority graduate students who then compete for NASA support. Students selected for the program collaborate with university investigators and NASA technical officers. Stipends are $16,000 for up to three years, supplemented by a $3,000 university allowance and a $3,000 student allowance for tuition and books.

As in the *Graduate Student Researchers Program*, minority students selected by NASA field centers must spend a period of time—from several days to several weeks—at the center, taking advantage of its research facilities and working with center personnel. Students selected by NASA Headquarters will be offered an opportunity to work at a field center engaged in related work.

Students attending HBCUs are encouraged to apply to the Graduate Student Researchers Program, but are ineligible for the Underrepresented Minority Focus Component, since they have access to NASA fellowships through other programs between NASA and HBCUs.

Observations. In the summer of 1991, 94 students were in the Underrepresented Minority Focus Component; 57 were pursuing the Ph.D. degree, and 37, master's degrees. More students in the minority program (40 percent) are seeking master's degrees, whereas 90 percent of the students in the Graduate Student Researchers Program are pursuing the Ph.D. degree. NASA is looking into the reasons for that difference.

The minority program also is not as competitive as the regular program. The Graduate Student Researchers Program receives about eight applications for every student selected; in 1991 the Underrepresented Minority Focus Component was undersubscribed, and NASA was trying to do some targeted recruiting for it.

NASA's Space Grant College and Fellowship Program. Established by Congress (Public Law 100–147) and funded since 1989, this program has among its objectives the recruiting and training of professionals, especially women, underrepresented minorities, and persons with disabilities, for careers in aerospace science and technology. Under the fellowship portion of the Space Grant program, designees awarded nearly 300 undergraduate and graduate fellowships and scholarships in 1990. Approximately 15 percent of the awards went to minorities, and 30 percent to women.

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NASA Langley Aerospace Research Summer Scholars Program (LARSS). To motivate science and engineering students to earn Ph.D. degrees, seek careers in research, and develop an awareness of employment opportunities with NASA, NASA formed LARSS in 1986. Twenty-five students were in the inaugural group that summer, and 90–100 students participated in the ten-week research program in the summer of 1991. Each participant receives a $4,000 stipend, and the cost of the program is funded from NASA's budget for research and development.

Summer scholars are expected to conduct research with a mentor and produce a paper on the research activity. To be eligible to participate in the program, a student must be a rising junior, senior, or first-year graduate student (freshman students who participated the first year were demotivated by the rigors of research); have a 3.00 GPA on a 4.00 scale; be an engineering or science major; and have a strong interest in research, a letter of recommendation, and a resume. In the last two years, LARSS has modified the GPA requirement so that about five percent of their students are undergraduate science and engineering students with 2.3–2.4 GPAs. The program is beginning to experiment with mid-range students to find out if they can be prepared and motivated to seek the Ph.D. degree.

LARSS's intake survey at the beginning of a summer program included questions about graduate education. Only 25 percent of the students were interested in going to graduate school. After a summer of working under a mentor and listening to special career lectures, and participating in related program activities, 75 percent of those exiting the program indicated an interest in attending graduate school. Thus, LARSS appears to be successful in its efforts to motivate more students to pursue the Ph.D. in science and engineering.

NASA-University of Virginia Programs. In the University of Virginia experience, the impetus for increasing minority graduate enrollment and retention must come from partnerships with industry and government. NASA research grants at the University of Virginia not only provide financial assistance but require that minorities be involved in the research. That requirement makes faculty acutely aware of the importance of minorities in research and motivates them to find or "grow" talented, capable young researchers. This approach has helped the University of Virginia increase its graduate enrollment of minorities in engineering from four to 54 within a four-year period of time. The success of the graduate program has helped undergraduate recruitment and retention by providing role models, excellent teaching assistants and tutors, and researchers. UVA won a national award for an 88 percent retention rate of all students, including minorities.

To increase minority enrollment and retention at the undergraduate and graduate levels at the University of Virginia, the associate provost for academic support developed comprehensive support programs. Through a variety of programs, they seek to identify students, to prepare them, and to motivate them in high school. Introduction to UVA is a university-wide program for rising high school seniors, minority and non-minority. It brings them to campus for a week in July to attend

lectures, participate in laboratory demonstrations and tours, and gain first-hand computing and writing experience. A similar program is called the Minority Introduction to Engineering.

A Minority Research Assistantship Program for rising high school juniors gives them an opportunity to spend three months in the summer working with engineering faculty in their labs on campus. The program has been very successful because it does not coddle the students; they are screened very carefully and once they are in the program, they become full participants in a faculty member's research team. They actually learn computer programs, observe and help graduate students, and do computations. Many of the participants enroll in engineering programs at UVA or other institutions.

The University of Virginia has arrangements with the Southeast Consortium for Minorities in Engineering (SECME) and the Cooperating Hampton Roads Organization for Minorities in Engineering (CHROMES)—consortia with elementary, high school systems, colleges, and corporations seeking to increase the enrollment and retention of minorities in engineering. UVA works with these consortia to ensure that potential students are identified properly and prepared well. A result of these efforts is that 350 blacks enter UVA every year, and their retention rate is high.

Once the students are on campus, the university assists them with tutorials; a strong, proactive faculty advising program; an early warning system to identify students who are not going to class or doing homework regularly; and scholarships. Minority students often have to drop out of school because of personal or familial financial emergencies. A small loan fund in the office of the associate provost for student academic support is available to help students in such emergency situations. Every loan made under those circumstances in the past three years has been repaid. One of the challenges is to get funds from various sources so that support is available for students who need help.

Internships give students an early exposure to the professions. In Project View corporations bring students in for a week or two during the Christmas break and show them what the profession entails.

In the graduate component, about one-fourth of UVA's minority graduate students have been supported by NASA grants. Some already have received their Ph.D.s and are working in industry or academia. Many others are in the pipeline working on their Ph.D. or master's degrees.

Money is the critical missing ingredient. NASA, GEM, and the National Consortium for Educational Access, among other agencies, provide invaluable support to the University of Virginia. To expand the group of minority graduate students significantly, however, greater financial support is needed. Funds must be available for minority students whose undergraduate academic records may be uneven, but who have the potential to succeed in graduate school if they are given the opportunity and the support.

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Institution-Institution

Tougaloo College-Brown University

In 1963 the presidents of Tougaloo College and Brown University, who were friends, decided to form a partnership between the two institutions. Thus began the longest-lived institutional relationship between an HBCU and a major research university.

At the outset, the relationship was very paternalistic. Brown University in Providence, Rhode Island, was the giver—fund raiser, source of faculty expertise—to Tougaloo College in Jackson, Mississippi. The faculty exchange program was one-way: Brown faculty became visiting professors at Tougaloo College, helping the faculty there transform a teacher's college curriculum into that of a liberal arts college. Tougaloo faculty members did not go to Brown.

The undergraduate exchange program was a real exchange from the beginning. Between 1967 and 1991 some 150 undergraduates have moved back and forth between Tougaloo and Brown. At first the exchange was general; students went for the enrichment of the semester and were not locked into a curricular scheme. Now some sentiment exists to use it to encourage Tougaloo students who show promise in a certain discipline to come to Brown and take courses in that field, with a view toward entering graduate school at a later date.

Five students have participated in the joint degree in engineering program and between five and six students in other graduate programs. The longest running component of the relationship is the Early Identification Program in Medicine (EIP) in which 30 students have taken part.

Early Identification Program in Medicine. The EIP was developed in 1981 by the Brown Medical School administration and the director of Tougaloo's Pre-Health Careers Program. Brown hoped the program would increase minority, especially African-American, representation in the Medical School student body. Tougaloo hoped the program would attract more students to careers in medicine, improve their preparation, increase the numbers of medical school options for their graduates, and guarantee placement in medical school.

On the recommendation of the Tougaloo faculty, in consultation with their Brown counterparts, two to three Tougaloo pre-med students are identified at the end of their sophomore year and guaranteed admission to Brown upon the successful completion of their Tougaloo education. They are formally notified of their acceptance and urged to participate in research and educational programs at Brown during the next two summers.

Two types of summer programs exist: research and didactic. The first summer usually is spent in one of the teaching hospitals under the tutelage of a Brown-affiliated faculty member in a research project. During the second summer the student takes courses based on needs identified by the Tougaloo faculty in relation to the Brown curriculum and the special needs of the student. Upon the completion of their Tougloo degree and the summer programs, the students matriculate at Brown.

Funding for the summer programs comes from such federal and private sources as MARC, Health Careers Access, Southern Education Foundation, and the Howard Hughes Medical Research Institute. Travel, room and board, a stipend for the students and, at times, research support have been provided. Upon admission to the Medical School, the university's regular financial aid system takes over.

The EIP has had far more successes than failures—only five in ten years and of those only one was an academic failure, the others largely matters of social adjustment. Brown is now trying to emulate the EIP in other disciplines, especially biology, education, and history, to see if the model can be adapted as a way to entice more young people into teaching and research careers. The key problem is money: how to finance this kind of program in non-science fields where faculty members do not have the same kinds of research support as their colleagues in medicine. It is easy to identify the students, relatively easy to develop relationships between administrators and faculty, but difficult to finance.

After many years, Brown and Tougaloo recently have developed some structures to guard against a paternalistic relationship. Essential to a strong interinstitutional relationship is the endorsement of trustees and presidents. A written memorandum of understanding outlining the key ingredients in the relationship and the principles that inform it should be adopted by the boards of trustees at both institutions. The Tougaloo-Brown relationship thus has been restructured in the following ways:

(1) At both institutions there is now a Tougaloo-Brown Relations Committee that is approved by both Boards of Trust. It is important to have the relationship firmly based in the Boards of Trust.

(2) The presidents of both institutions meet regularly, and they, board members, and faculty participate in each other's commencement exercises.

(3) Brown and Tougaloo share to some degree in joint fund-raising efforts.

(4) Both institutions have begun to share equally in the cost of the exchange. In the past Brown paid for the coordinator of the project. Now each campus has designated a coordinator, and the funding for the effort is borne by both institutions.

(5) The faculty exchange component is being enhanced through the sharing of faculty and research resources.

Lessons Learned. (1) Minority students may need special support systems. (2) Appreciate the diversity of educational experiences and avoid superior-inferior approaches to anything that is done. (3) Brown, a highly secular, urban, "posh" university is not the best place for everyone. (4) Build and nurture strong, trusting relationships between key faculty and administrators. (5) Establish guidelines and rules that protect each institution with regard to the recruiting of students and faculty. (6) Leave the student identification largely in the hands of Tougaloo faculty who know better than the Brown deans who is likely to succeed at Brown. A proper "fit" between the student and the environment is important. (7) Determine from the beginning when students may travel from one institution to another. Students must be sophomores or older to participate in the Brown-Tougaloo exchange. (8) Have

good pre- and post-advising of exchange students who go to both institutions. (9) Coordinators at both institutions should advise students regarding details of the application process: financial aid forms, housing and travel arrangements, and the selection of courses. (10) Money must be available to maintain these candidates. (11) Set up clear rules and regulations regarding transfer of credits and the cost factors involved in the exchange program. (12) Establish at the outset the boundaries of the relationship in a written document agreeable to both parties. (13) Have the president or another university official host a reception for the exchange students on each campus.

Advantages. The Brown-Tougaloo relationship provides graduate and professional school opportunities for many African-American students at Tougaloo who might not have pursued these opportunities otherwise. It enables faculty and students to experience cultural diversity; some Tougaloo faculty members now have been to Brown to teach and conduct research. Faculty and students who participate in the exchange establish beneficial lifelong relationships with each other.

Advice. Brown and Tougaloo commend the interinstitutional relationship as a possible model, but it entails hard work, requires commitments at the highest level, and is expensive. Institutions that wish to engage in these programs have to commit themselves to providing a large portion of the funding out of their own operating and financial aid budgets. External funding is difficult to find.

Consortium for Graduate Opportunities for American Indians

Consortium members[10] are sixteen colleges and universities that have an institutional support infrastructure for Native American students. They cooperate in the recruitment of American Indian students to academic graduate programs in social sciences, humanities, sciences, and mathematics. The objectives of the Consortium are to identify a specific pool of undergraduate students at participating institutions and to provide systematic ways in which they may be encouraged to pursue graduate study.

Among the sixteen institutions are community colleges, four-year institutions, and research or aspiring research universities with graduate programs. Clara Sue Kidwell at the University of California at Berkeley was instrumental in founding the Consortium. Based on an informal network of people she had met over the years in working with Native American Studies programs, she sought to create an old boy/old girl network that would identify talented undergraduates, encourage them to attend graduate school, and assist them in getting into graduate school The Consortium was founded in 1985. For the first three years it had funding from The

[10]Haskell Indian Junior College, Lawrence, Kansas; Navajo Community College, Tsaile, Arizona and Shiprock, New Mexico; Fort Lewis College, Durango, Colorado; Montana State University, Bozeman; Northern Arizona University, Flagstaff; Northeastern State University, Tahlequah, Oklahoma; Southeastern State University, Durant, Oklahoma; University of Alaska, Fairbanks and Anchorage; Universityof Arizona, Tucson; University of California at Berkeley, Los Angeles and Santa Cruz; University of New Mexico, Albuquerque; University of Utah, Salt Lake City.

Ford Foundation. Thereafter Northern Arizona University became the headquarters for the Consortium, but there has been a struggle to get the financial support necessary to run this kind of coordination effort.

In its first three years the Consortium held 36 workshops, attended by some 500 students, to discuss reasons for attending graduate school and ways to finance it. A great deal of effort is spent on assisting students with applications to graduate schools and helping them identify sources of support.

At two faculty-student conferences scheduled in the early years of the Consortium, students talked about the research they were doing, and the faculty, some of whom were Native Americans, talked about why they went on to graduate school and their experiences there. One of the strengths of the Consortium is that it is able to organize a network of a limited number of Native American faculty members scattered across the 16 member institutions. Students therefore may have an opportunity to meet a Native American faculty member in their discipline even though there is not one at their home institution.

Now the Consortium is essentially an information-sharing network. For example, a student interested in forestry can send his or her name to the Consortium. Using a computer database, the Consortium sends the student's name to the schools that have a forestry graduate program. They also share information about financial sources and deadlines.

Lessons Learned. To make the Consortium truly effective, someone on each campus (a dean or someone in student affairs) needs to be committed to keeping the network alive and getting the faculty on campus to cooperate with those on other campuses. The Consortium needs a central office to share the information coming in and out. Member institutions need to develop and sign a formal agreement, contribute a small amount of money to a fund to help with such communications as a newsletter, and seek other support to cover the administrative overhead of the Consortium. In addition to coordinating the information exchange, the money could be used to send faculty members from one institution to conduct workshops at several others.

Ft. Lewis College in Durango, Colorado, is one of the Consortium's member institutions. It waives tuition for Native American students and has continued the tradition begun by the Consortium of having on-campus workshops to inform students about graduate opportunities. The college also encourages its Native American students to consider getting their Ph.D.s and returning to Ft. Lewis College to teach; the new president there is very supportive of a "grow your own" philosophy.

Encouraging Minority Participation in Graduate Education

Helping Minority Students Who "Stop Out"

Seeds of the graduate school idea planted in a minority student's mind may take a period of time to germinate. Many minority students are so financially burdened after four years of college that they need to earn some money before they go on to graduate school. Many of them do take time off but decide several years later to

return to graduate school. Consortia and university representatives can provide useful services for those students by giving them the information and assistance they need when they make a decision to attend graduate school.

They can keep in touch with those students; continue to encourage the students' aspirations for graduate education; provide information about graduate programs and funding; and assist them in preparing for GRE tests, completing the application, and getting their recommendations up to date. Consortium offices, minority student offices, or other identifiable places where the students know they can go for information and assistance may be especially effective in that regard.

Many minority students also tend to set educational goals in achievable increments. As they consider graduate school, a doctoral degree may seem overwhelming but a master's degree attainable. University representatives who work with minorities may be wise to encourage this incremental thinking, urging students who are undecided about their goals in graduate school to work first toward a master's degree and then persuading them to continue for the doctorate. The process requires staying in touch with those students, continuing to encourage and help them.

Recruiting through Student Organizations

The GEM Program (National Consortium for Graduate Degrees for Minorities in Engineering and Science, Inc.) has found student organizations to be an important component of successful recruiting into graduate programs. In engineering, GEM relies heavily on student organizations, e.g., American Science and Engineering Society, Society of Hispanic Professional Engineers, Mexican American Engineering Society, Society of Black Engineers, to let undergraduate students know about GEM fellowships. These student organizations have national constituencies and chapters all over the country. Consortia seeking to encourage minority students to pursue graduate degrees need to involve these organizations in their planning and recruiting efforts.

Faculty Members as Effective Graduate Recruiters

Undergraduates often perceive life as a faculty member to be dull and uninteresting. Professors need to tell undergraduate students about the exciting aspects of being a faculty member: that it is one of the few professions where a person can spend a lifetime doing what interests him or her most; that they are able to teach others about the field they love; that they have the flexibility to teach or do research at other institutions or abroad.

Graduate deans, administrators of consortia, and minority student offices need to schedule workshops, conferences, or meetings where faculty members and graduate students tell undergraduates why they decided to go to graduate school and become professors and what they like about the profession. Departments, as well as graduate schools, can conduct workshops on applying to graduate school. The CGS publication, *Graduate School and You*, can be distributed widely among faculty members and undergraduates.

Faculty members need to be made aware that they can encourage their best students to consider a professorial career through interactions in the classroom and outside. At

one university a graduate dean visited departments and talked to the department heads about encouraging their own students to go on to graduate school. A university president at a large midwestern university invited all the top minority students and all the minority faculty members to his house for dinner, and he asked the faculty members to talk about why they went into academics. A Mexican American student in agricultural economics who attended that dinner now is planning to go on for the doctorate. Faculty members who are enthusiastic about their careers can be the most effective missionaries of graduate education on campus.

Providing Money/Taking Calculated Risks

To expand the pool of minority students in graduate education will require additional money from a variety of sources for research fellowships or research assistantships. It also will require some flexibility in assessing a student's potential for graduate school when the GPA and GRE scores are not outstanding. Flexibility in applying standards must not, however, be done in such a way that minority students are identified as second-class citizens and ghettoized.

Mechanisms for addressing this issue already are used in some of the institutional arrangements described in this document. In the Brown-Tougaloo Early Identification Program in Medicine, Tougaloo faculty members identify and recommend students who they believe will succeed in medical school at Brown, and Brown University has learned over the years to trust their judgment. A similar relationship pertains in the CIC Alliance for Success. The six member HBCUs recommend their most able students for the Summer Research Opportunities Program, and students who have successful experiences in the SROP may be admitted, with financial support, to graduate school at a CIC institution even though their GPAs and GRE scores are less than optimal. The critical variables are relationships of trust among faculty members at the sending and receiving institutions, and the opportunity for minority students to have summer research experiences at a major university.

A third mechanism is the Undergraduate to Graduate School Bridge Program in the LBL/JSU/AGMEF Science Consortium. This bridge program offers students who have received their B.S. degrees from JSU and AGMEF an interim year of research at LBL so that they can gain additional experience before entering graduate school.

Universities that do target some graduate assistantships for minority students can insist that departments use them for that purpose or lose them. This requirement gives departments an incentive to look harder to find qualified minority students, not to admit those who are unqualified.

Financial assistance to minority graduate students is most effective when it is given as a research assistantship or research fellowship. The award should be prestigious but also should involve the student in the research and, in some cases, the teaching activities of the department from the very beginning. The retention rate of women and minority students with research assistantships and teaching assistantships tends to be higher than for those with straight fellowships.

Principles of Effective Institutional Cooperation

A Range of Options

The consortial arrangements described herein vary greatly, from two-member partnerships between universities or a university and a corporation to such multi-member consortia as the CIC Alliance for Success. The consortia may be comprehensive or non-comprehensive, and the numbers involved may vary accordingly. If a consortium deals with a particular issue, it may be easy to have a number of organizations involved; if it is comprehensive, however, it may be more effective to limit the numbers of institutions participating.

Comprehensive consortia seek to touch all bases, beginning with pre-college programs that can extend to grade school and progressing through summer and academic year research experiences to a transitional year of research between college and graduate school. In addition, comprehensive consortia may deal with all academic disciplines. Thus, comprehensive refers to breadth, either in parts of the pipeline or academic interest. Noncomprehensive consortia are more focused, and, as in the example above, can focus on a particular transition, such as undergraduate to graduate, or on a particular discipline or set of disciplines, such as science and/or engineering. Assessing the success of those programs in channelling more minority students into graduate education will provide valuable insights into the relative effectiveness of these approaches.

Promoting a Triangular Relationship Through Institutional Partnership Programs

Partnerships among institutions—research universities, national laboratories, or corporations paired with smaller institutions that have large minority populations—should enhance the work of all the participating faculty members and students. A priority should be to promote the triangular relationship among students, faculty members at the undergraduate institution, and faculty members or research scientists at a research university, national laboratory, or corporation.

At a minimum, faculty members at the research university and undergraduate institution should talk with each other and develop an ongoing relationship based on trust. They share a mutual interest in the students who participate in the summer programs and who may go on to graduate school. They should be able to discuss the student's progress and problems, understand the research in which he or she is engaged, and encourage the student's work and progress toward graduate school during the summer and the academic year. Through a stable, long-term relationship, the faculty member at the research university becomes able to trust the undergraduate faculty member's recommendations of students who can succeed in summer research programs and in graduate school. Consortia among institutions, such as the CIC Alliance for Success, can foster these ties by bringing together faculty members in a particular discipline, e.g. mathematics, from the participating institutions to discuss curriculum development and institutional changes that would be beneficial to all students.

In some institutional partnerships faculty and students alike derive benefits from the arrangement. The Lawrence Berkeley Laboratory/Jackson State University/Ana G.

Méndez Educational Foundation Science Consortium gives everyone involved an opportunity to participate. Students and faculty members at JSU and AGMEF are involved in collaborative research projects at LBL as well as at their home institutions. Research scientists at LBL and faculty members at JSU and AGMEF get to know one another through their shared research, and both are in a position to encourage and guide participating students throughout the year. Professors at JSU and AGMEF are enthusiastic about gaining access to major research projects without having to give up their primary role as faculty members. LBL in turn gains access to minority students and faculty members. The triangular relationship is mutually satisfying and reinforcing.

Foundations of Institutional Partnerships

1. Begin with a written memorandum of understanding stating the terms of the relationship and the principles that inform it. Careful planning should clarify what each participant hopes and needs to gain from the relationship.

2. Top administrators and the governing boards of the institutions involved should give the agreement their official approval.

3. A lead institution or organizational body should be in charge of the consortium or partnership.

4. Adequate, stable funding must be secured.

5. All members should provide administrative support.

6. Regular meetings should take place among coordinators from all of the participating institutions. Communication among the participants should be full and timely.

7. Inter- and intrainstitutional planning should be ongoing.

8. In cooperative projects among or between universities, the process of finding summer research placements for students should be decentralized so that an institution's undergraduate colleges and departments claim ownership of the program and remain committed to it.

9. Benefits should accrue to all the members.

10. Whenever possible, institutional partnerships should help strengthen science, engineering, and technology programs at the colleges or universities with a large minority student population. Institutional and faculty development benefits a much wider number of students than do summer research programs for a limited number of students.

11. Involvement with students should begin at the pre-college level.

12. Consortia and partnerships should consider the utility of providing minority students with a bridge year after their baccalaureate degrees, which would give them additional research experience before they enter graduate school.

13. Institutional patience should be present, permitting a long-term commitment to the partnership.

14. Evaluation of what the program has accomplished is essential. Tracking the post-baccalaureate careers of the minority student participants is especially important. Because the objective of these institutional partnership programs is to increase the numbers of minority students in graduate education, an accurate tally of the numbers must be kept. The success of any cooperative arrangement ultimately will be judged by the numbers of students it puts into the graduate school pipeline.

CGS Idea Exchange Summer Meeting 1991 Participants

Institutions and Consortia

CIC Alliance for Success
- Dr. Jean Girves, Committee on Institutional Cooperation
- Dr. Elaine Copeland, University of Illinois
- Dr. T. J. Bryan, Coppin State College

The Consortium for Minorities in Teaching Careers
- Mr. José F. Méndez, Ana G. Méndez Educational Foundation
- Dr. Max Weiner, Fordham University

Institutions and Corporations

The Science and Technology Alliance
- Mr. Richard Stephens, Department of Energy

Tuskegee University-Hughes Aircraft Company
- Dr. Vascar Harris, Tuskegee University

Institutions and National Laboratories

Lawrence Berkeley Laboratory/Jackson State University/Ana G. Méndez Educational Foundation Science Consortium
- Dr. Bettye Fletcher, Jackson State University
- Dr. Rollie Otto, Lawrence Berkeley Laboratory

NASA Programs
- Ms. Nancy Knott, NASA
- Ms. Elaine Schwartz, NASA
- Dr. Samuel Massenberg, Langley Research Center
- Mr. Robert Yang, Langley Research Center
- Dr. Ron Simmons, University of Virginia

Institution-Institution

Tougaloo College-Brown University
- Dr. Bettye Parker-Smith, Tougaloo College
- Dr. Charles Baldwin, Brown University

Consortium for Graduate Opportunities for American Indians
- Dr. Henry Hooper, Northern Arizona University
- Dr. Clara Sue Kidwell, University of California, Berkeley
- Dr. Mary Jean Mosely, Ft. Lewis College

Workshop Chair

Dr. Leslie McLemore, CGS Minority Committee/Jackson State University

Other Attendees

Dr. Mark Clark, CGS/University of Northern Colorado

Mr. Hector Garza, CGS Minority Committee/Eastern Michigan University

Dr. Ted Habarth, The GEM Program/Johns Hopkins University

Dr. Russell Hamilton, CGS Minority Committee/Vanderbilt University

Ms. Kay Hancock, Vanderbilt University

Dr. Mack Johnson, CGS Minority Committee/California State University, Northridge

Dr. Jules LaPidus, CGS

Dr. Thomas Linney, CGS

Dr. Jacqueline Looney, CGS Minority Committee/Duke University

Dr. William McHenry, CGS Minority Committee/National Science Foundation

Dr. Frank Morris, CGS Minority Committee/Morgan State University

Dr. Russ Snyder, Asst. to the Director, Committee on Institutional Cooperation

Dr. Mike Sullivan, Project 1000

Mr. Peter Syverson, CGS

Dr. Deborah Thomas, CGS Minority Committee/Yale University

Dr. Judith Toyama, CGS Minority Committee/University of Massachusetts, Amherst

Dr. Reginald Wilson, American Council on Education

Mr. BOUCHER. Thank you very much, Dr. LaPidus.

Well, the testimony of this panel, with the exception of Dr. Morris' statement, suggest that there may be some rather significant problems with the legislation as introduced, and those, as I have noted them, have been the fact that a signal might be sent of an adverse nature to universities, perhaps to foreign student as well, concerning the extent to which foreign student should be accepted at U.S. universities; the effect that the bill might have on the quality of graduate programs generally and on the quality of the research effort at universities; the cost; and the fact that probably this is not a particularly good way to encourage more American students in these graduate disciplines.

That being said—and we have a very thorough recitation from Dr. LaPidus of the kinds of programs that are in place that are designed to address these problems—let me ask this simple question. Should we conclude that because of these programs that in place enough is done? Is that a sufficient way to address the range of problems that have been identified? Is there anything else we ought to be looking at? Is there any action that we as policymakers should be taking at this time?

And, Dr. Penner, let's begin with you, if you would care to tackle that.

Dr. PENNER. No. I would certainly argue that not enough is being done.

Mr. BOUCHER. Could you use the microphone, please?

Dr. PENNER. I would certainly argue that enough is not being done. That there is progress. The progress is very slow. One would expect the progress to be slow, because after all it takes 4 years to train an undergraduate and it takes another 5 or 6 years after that to make a Ph.D. So we're obviously dealing with a long-range issue.

But when I look at the statistics that are available on the K through 12 program, when I look at the makeup of our undergraduate students as they come in, I think it is very clear that not enough is being done to interest a much larger group of people in science, in mathematics, and in engineering.

Mr. BOUCHER. What should we do to address the problem?

Dr. PENNER. We need enrichment programs from the very beginning in these areas. We need to have better teachers, better instruction. And, now I don't want to except the universities either. We also have something to do in the university programs. I would say that our primary problem in the universities is doing an adequate job in our undergraduate teaching, which is limited because the number of teaching assistants that are available that are really required to do a better instructional job and reduce the attrition that we encounter in these special fields. In order to do that, we need to increase significantly the number of students—the number of student TAs to support the college professor teaching at these levels.

There is a great deal that can be done at all levels including the universities, and I think without that the progress will be too slow and, I think, in the long run, inadequate considering the competition that we have on the international scene.

Mr. BOUCHER. Well, I think you've further stated the broad kind of need that we have. Can you be a little more specific about what

we as lawmakers might do to address it? What kinds of legislation, if any, should we consider enacting at this point?

Dr. PENNER. Well, I, first of all, would fall back to the committee report that it would be a very good idea to have a substantial increase in the number of fellowships in these areas that are restricted to U.S. citizens. We recommended that. There was some response to that but it is nowhere near enough.

And we would—I would certainly say that we should have increased budgets from NSF and from other agencies to increase the number of teaching assistants in order to reduce attrition. Those are two specific areas where funding is needed.

The funding in terms of the job that has to be done is not at historically high levels. On the contrary, it is at historically low levels. Chancellor Atkinson in his memorandum refers in particular to that point. That if you take a long look back, we are nowhere near where we would have been if we had continued, say, the way we were doing in the mid-Sixties.

It is not a very happy conclusion to say we need more money. But unfortunately, that's really what it boils down to.

Mr. BOUCHER. It is not an unusual statement that we hear in this room.

[Laughter]

Mr. BOUCHER. Dr. Powers, would you care to comment?

Dr. POWERS. The strength of the legislation, I felt, is the way in which it contributes to a sense of urgency on the part of universities. It's certainly true that an entering class today, an entering freshman class is better prepared than it was probably 5 years ago. There are more minority students, more women. But it is not true that it is a good class, especially by international standards.

At Tech our class, freshman class, will be about like that in math and ACT scores of Michigan or Michigan State. Be about 50 percent from the top 10 percent of the graduating class, about 20 percent—about 10 percent valedictorians. It's a good class. Of 1000 freshmen, only about 300 will be able to take calculus. Only about another 300 will be able to take a precalculus course in college algebra and trig, and that's not unusual at Tech. In fact, that class is much better than the class in most American universities.

I think action which adds to the sense by a university faculty, by all faculty, by faculty who need to have their grants funded, that the preparation of freshmen is an urgent matter to them. I think that's good and necessary legislation.

Mr. BOUCHER. All right, thank you.

Let's see. Dr. LaPidus, would you care to comment any further? We've just heard from you on this, I think.

Dr. LAPIDUS. Yes. And I agree with your comment, Mr. Boucher, that it's easy to talk about increases in money, and I think that in many cases increases in money are certainly called for for the support of qualified American students to go on. I think, for example, that some of the provisions of Title IX of the Higher Education Act, the reauthorization, particularly those dealing with early identification and the Patricia Roberts Harris Program, need to be funded at higher levels.

But I have to say that in addition to funding, and maybe outside of the range of funding, a major issue being discussed in all Ameri-

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can universities today at the Ph.D. level is how to do a better job. How faculty can do a better job interacting with students. How we can try to ensure that more of the students who enter get through and graduate from these programs. And, while some of that has to do with money, because indeed a very important factor in students finishing programs is support, as you might expect.

But there's more to it than that, and I think there's a good deal of attention being paid in all American universities to program issues, faculty issues, atmosphere of support issues—support in the broad sense, not in the financial sense—that I think will both effect long overdue changes in the way American doctoral education is being carried out.

Mr. BOUCHER. Thank you. Dr. Morris?

Dr. MORRIS. Thank you, Chairman Boucher. There's just one thing I think we need to point out that's not directly related to additional cost. We all agree that we need additional cost. But, if we do not have an adequate access of Americans, and especially American minorities, to the research, federally supported research assistantships, then mentoring and other kinds of opportunities are lost. Opportunities for mentoring, opportunities for research experience that often gets translated into speed of degree.

ETS has done some other studies that have shown that often minorities who come in get fellowships or get special kinds of funding that's outside the mainstream. The department does not own them. They do not get worked into the system. And what happens is that those who get to know the professors better in research assistantships then the professors believe that these are—you know, you get a reinforcing factor which leads them to want others that are like that. And those who are outside of that—and, believe me, let me just tell you we minorities have been outside those loops—even when we complete degrees, do not complete them with the amount of research, reinforcement and opportunities that it's a headstart for a postgraduate.

So we need to recognize that the allocation, the central issue that this bill address, the allocation of these prime and numerous Federal research assistantships should be equally shared.

Mr. BOUCHER. Okay. Thank you very much.

Gentlemen, that concludes my questions, and at this time the Chair recognizes the gentleman from California.

Mr. PACKARD. I think that some of the witnesses may have addressed this, but I'd like to pursue it just a little bit further. And that is, is it possible for us to achieve the goals of the bill, which I think we're all interested in, in a better way than what the bill does? What other programs or are there other ways to achieve the goals that we're trying to achieve in giving equal access to American students without some legislative strategy?

Dr. Powers, I see you very tempted.

Dr. POWERS. Well, the goal that I would describe is one of urgency in the sense of university faculty. Secondary and middle school preparation needs to be improved, and that university faculty should be involved in that chain. It's not enough for us to have a program that does a better job in first-year mathematics. It's very important that at the universities we have programs that engage

us with secondary and middle schools. And that's a matter of developing that sense of necessary urgency. I don't have a better idea.

Mr. PACKARD. Mr. Penner?

Dr. PENNER. Mr. Packard, I'd like to give you an example of what can be done and what is required to have some substantial increase and success. I've taught for very many years a kind of a core course at the undergraduate level in engineering, namely, thermodynamics. I taught it at the California Institute of Technology and later at the University of California in San Diego. I'm talking now about large numbers of students. There might have been in recent classes 200-250 students in the class.

Now, looking at this from a historical perspective, I find that—found that about one-third of the students in a core course that is really required for graduation simply could not make it the first time around. However, that same course taught with adequate TA support so that the students had available essentially tutoring as needed and as required would reduce this attrition by two-thirds. And that's why I'm saying that having more support for TAs for crucial courses is certainly one way to reduce losses and increase the number of Americans who successfully make it in a very difficult field such as engineering.

Dr. MORRIS. Mr. Packard, there are really some good studies that have really showed how to address this in a comprehensive way. I mean, we don't think about it, and I know it's beyond the scope of this committee to realize how grossly unfair it is to fund American education—a child is in—public education is available—has resources available depending upon where he or she is lucky enough to live.

To give you one example, through the QEM studies we pointed out that many, or the majority of minority students in this country, especially African-Americans, are in high schools where advanced math and advanced placement English isn't even offered. These are the things which the ETS test which some later faculty member is going to use as the basis for judging their potential and their abilities and compare it with an international student and they don't even have it on the curriculum, don't even have access to it. How is this fair? How is this a judgment? So I think we really need to do that.

And then the second kind of thing is that we need to look at the financial incentives. What are the financial incentives for a university department to select an American student vis-a-vis an international student? And, in our country, since we all pay taxes, shouldn't there be something? Shouldn't there be some incentive that will encourage them to have—to go out of their way, if they insist that that's what it is, to educate our own?

Thank you.

Dr. LAPIDUS. Just a brief comment, Mr. Packard. I think there are many programs that are in place right now that seem to work. One of the problems is that they're often disconnected from each other. This is a continuum. You can't just do something at the K through 12 level and forget about what happens next. You can't do something in a summer research program, and then drop the student for the rest of the academic year with no continuing reinforcement. This comes back a little bit to some of the things Dr. Penner

said, and that is, with enough support personnel, TAs, additional faculty, people who are involved and interested in working with students throughout this process from K through 12 all the way through graduate school, I think we'll succeed in producing more Americans.

Mr. PACKARD. Last question, Mr. Chairman. Do you—does the panel feel that we have done an adequate job in developing a database for following the careers of those that—both the international students, particularly foreign student, as they leave the graduate schools in terms of their career patterns both here and abroad or back in their own home country? Do we have an adequate database that would let us know whether our educational system is effectively providing for them the career opportunities, either if they choose to remain here in the country or even if they go back to their home country? Dr. Penner?

Dr. PENNER. We had information of this sort during the NAE study from the Office of Scientific and Engineering Personnel of the National Research Council, of which Dr. Fechter, who is here, is the director. And I believe that those statistics were pretty good. They were really very encouraging statistics. When we looked at engineering, we found that the initial retention, that is, the initial fraction of graduating Ph.D.'s in engineering who remained in this country, was probably 55 to 60 percent. And then of those who returned to their home countries, an appreciable fraction later came back as permanent immigrants to the United States. So the fraction of people ultimately ending up as citizens is very large. I would say it's probably easily 70 percent, and perhaps more than that. And then went on to make the point the people who don't end up here who are in other countries but have been educated by us are in a sense essential to us. When we look at the international scene of exchange of information, of trade, of partnerships in business enterprises, they are not lost. I think it's in that sense also of value to our country.

Mr. PACKARD. So, in fact, those statistics would bear out that the investment that we make in our universities into the careers and into the training and education of our international students, in fact, perhaps brings back as much as our investment is or better?

Dr. PENNER. I think we would have judged that we were actually benefiting because there was this entire long period before they entered graduate school, some 20 years, 19 years of education, of support, of upbringing, that we didn't pay for at all. So we really only paid for the tail end of the education, and I think we ended up the net beneficiaries of that exchange.

Mr. PACKARD. Thank you so much.

Mr. BOUCHER. Mr. Henry, you have 5 minutes.

Mr. HENRY. Thank you, Mr. Chairman. I want to thank each of our panelists. I think we've had a very helpful and encouraging discussion, and I appreciate each of you being here.

Mr. Chairman, I'd like, first of all, if I might ask for unanimous consent to keep the hearing record open for 5 legislative days for any other written testimony that may be sent in to the committee?

Mr. BOUCHER. Without objection, so ordered.

Mr. HENRY. Thank you. Then, Mr. Chairman, simply as a matter of courtesy I would like to introduce the two panelists that I had

invited and you had generously agreed to have before us. Dr. Morris is known to many of us because of his former staff work here on the Hill with the Congressional Black Caucus, and is now chairman of the Council for Historically Black Institutions and dean of the faculty at Morgan State and a political scientist, as am I.

Secondly, Dr. William Powers from Michigan Tech in Houghton, Michigan—not "Howton," Mr. Chairman, if you don't mind my correction. Many people would not recognize that Michigan Tech is not only a nationally regarded but internationally regarded institution in terms of the area of engineering and engineering sciences, and, if I'm not mistaken, graduates more graduate engineers than the University of Michigan, to the surprise of many even of my own State. I also want to point out that Dr. Powers, who is Provost there, his first professional job was with the Henry Publishing Company in New York City, although no relationship.

One of the questions staff posed to us and the theme that has come over, particularly with Dr. Powers and Dr. LaPidus and Dr. Hancock, not with Dr. Morris—no, Drs. Penner and LaPidus, not Drs. Powers or Morris, is this kind of theme that enactment of the bill might be a disincentive to foreign students in seeking admissions to graduate schools, a disincentive to really—that somehow it's misdirected. My concern with this is that current policy and behaviors of the institution is, in fact, potentially a disincentive to U.S. students.

As a former faculty member—and I think, Dr. Powers, you sensed this, and when we met with your deans I think they understood this dilemma too. I have taught in both a, you know, a major graduate school and a smaller liberal arts school and it is very easy to get caught up in a faculty temperament of publishing and research at the expense of the institution's mission to the Nation and our society. I went through the hoops. I published a textbook. I published a popular book. I published journal articles and popular articles. That's how you do it. I remember how we used to joke in the coffee shop, half seriously but not quite so much, it was September, the students were back and now prohibited us from doing our work.

I think we are all academics here. Pardon my getting off of—I'm actually a little more comfortable with academics than fellow Members of Congress. It's my background.

That's the dilemma. And it seems to me that what I'm trying to do here is if, in fact, you have a standard here which is, I do not think, overly intrusive and simply says that when that money goes to the non-American student it goes there only because there wasn't a comparably qualified American student there, it sends a message up and down the academic ladder. The counselor at the undergraduate institution says to his aspiring undergraduate student at Michigan Tech or at Caltech or at Berkeley or wherever it is, "Look at that. There's money for you if you're as good as the other guy." That's, quite frankly, what dragged me into a graduate education—I had someone who as an undergrad showed me there was a ride there for me if I was in a situation to hitch my car to the train.

That's what we're trying to do, and hold it out. And also then to make our whole system, your graduate professors sensitive to reaching down to feeder institutions from where you get your students.

So I don't have the magic solution here, other than I'm intrigued by one of Dr. Penner's comments—and then we'll run off to vote, Mr. Chairman, and I thank you again for your generosity in letting me sit in here—saying, perhaps, then what we do need is more fellowships that are obviously designated under law strictly to Americans and fund them by offsets in general research grants to the institutions. That might be another way of doing it, and a way which wouldn't have the research or the reporting burden that some of you feel is egregious.

Thank you, Mr. Chairman. I thank our panel.

Mr. BOUCHER. Mr. Henry, thank you very much both for bringing this idea to us and for joining us here this afternoon as we examine it.

The subcommittee expresses its thanks to these witnesses whose testimony has been extremely helpful to you. And, with that, the subcommittee stands adjourned.

[Whereupon, at 3:20 p.m., the subcommittee was adjourned, to reconvene subject to the call of the Chair.]

APPENDIX

AMERICAN MINORITIES AND INTERNATIONAL STUDENTS: STRIKING WHAT BALANCE ?

ADDRESS TO THE PLENARY SESSION OF THE
COUNCIL OF GRADUATE SCHOOLS

by

FRANK L. MORRIS

DEAN

GRADUATE STUDIES AND RESEARCH

MORGAN STATE UNIVERSITY

DECEMBER 5,1991

WASHINGTON D.C.

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EXECUTIVE SUMMARY

AMERICAN UNIVERSITY PREFERENCES FOR INTERNATIONAL STUDENTS OVER AMERICAN MINORITIES, ESPECIALLY AFRICAN AMERICAN MALES

1.While President Bush and Education Secretary Alexander have focused upon race influenced minority (undergraduate) scholarships and have reversed the efforts of the Middle States Accrediting Association to consider university diversity in the accrediting decisions, they have conveniently ignored the much greater American university subsidies to international students who are not American citizens while at the same time requiring that a high proportion of African American, Hispanic and Native Americans who received doctorates pay for their doctoral education primarily by going into debt.

2. American Universities use discretionary funds that they receive from the federal government through subsidized research funding and they disproportionately give these funds to international students through research assistantships. These are the most desirable types of university support because it often permits working closely with faculty, getting joint publications and often having this joint research being the basis for the dissertation. This probably helps explain why minorities take longer to receive their degrees.

3. While American universities were giving doctoral funding preferences to international students over American minorities, they produced many more foreign student doctorates than American minorities in some of the most critical scientific fields of the future including mathematics, engineering and the life sciences. In some of these critical fields not a single African American doctorate was produced by American universities while they produced many subsidized non American citizens. This is a major step toward future continued second class citizenship for African Americans.

4.While there were great increases in international student doctorates since 1975(more than 60%) and a doubling of doctorates for Hispanics, Asian Americans and even Native Americans, African Americans were the only group to experience a decline in spite of a 40% increase in doctorates going to African American women. The reason was a more than 50% doctoral drop since 1975 in doctorates to African American males from American universities.

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5. The organizations which represent American universities supported changes in the 1990 immigration laws which made it even easier for more international students to come to American universities. They also supported changes to make it easier to recruit international faculty for future positions. This is consistent with the clear pattern of American universities and faculties valueing international students and faculty over American minorities,especially African American males.

6. In **every** field of doctoral and other professional study, American universities provide better funding to the international students who received doctorates over African Americans and often over other American minorities even in fields where there were a greater supply of American minority students who received doctorates. These fields included education, the humanities and the social sciences. There is no way international students should receive preferences over American minorities in these fields.

7. The funding issue is critical for American minorities, especially African Americans, pursuing advanced degrees because American minorities come from families with lower than average income and especially wealth than non minority Americans. They also have accumulated more undergraduate debt than non minority Americans. Thus the decision of American universities to give preference to non American citizens over American minorities is especially cruel.

8. American university graduate departments, especially graduate departments in the sciences, do not extensively recruit and fund American minority doctoral students where they are the most likely to be found specifically at the Historically Black Colleges and Universities and the large urban public comprehensive universities.

9. In 1975 68% of African Americans who received Ph.Ds went to work at American universities while only 52% of the international students who received doctorates in 1975 went to work at American universities. By 1990 American universities hired a higher percentage of international doctoral recipients than African Americans. Yet American universities claim they can't find African American faculty when in reality they hired only slightly more than half (55.8%) of the African Americans who received Ph.Ds in 1990.

10. Some nations are deliberately over producing graduates in some scientific fields with the expectation that their surplus will be given American university access and positions over American minorities.

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11. American universities are similar to the rest of American society and they continue to value non American citizens over American minorities especially African American males. As racial tensions have increased on campuses. African American males are seen as threatening. Yet ironically the most violent incident on American campuses last year involved a subsidized non American citizen in the sciences from Iowa university.

12. American graduate deans have not really challenged their doctoral departments on the preferences they give to international students over American minorities.

13. The university funding in the paper does not include state support of lower tuition and capital investments for public universities or the indirect tax subsidies to private universities through federal tax deductions for endowment and capital campaigns. African Americans and other American minorities are paying American taxes when American universities directly and indirectly use subsidized funds to primarily support international doctoral students and not American minorities.

14. The data in this discussion refers to people who have actual received their doctorates so there is no question of being qualified to do doctoral work.

15. The data in this discussion comes from the doctoral research project of the National Academy of Sciences.

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AMERICAN MINORITIES AND INTERNATIONAL STUDENTS: STRIKING WHAT BALANCE ?

During the past year President Bush and Secretary of Education Alexander have been concerned first, that scholarships based upon race were an unconstitutional advantage for African Americans. This was in spite of the fact that such scholarships had not been successfully challenged in the courts. Secretary Alexander also successfully carried out a campaign against the Middle States Accrediting Association to be sure that they would never fail to accredit a college or university regardless of what the institution did on the issue of diversity. While our highest federal education officials were concentrating on these racial higher education issues, they conveniently ignored a larger issue that will have even greater consequences for our nation in the future. That issue is the clear preferences American universities continue to give to non American citizens over American minorities and especially over African American males in access to doctorates from American universities, especially doctorates in both present and future critical scientific fields. Vernon Jordan, the former President of the national Urban League stated our American national issue most clearly...

> Today America finds itself at a unique moment in history. We stand as the world's foremost economic power. Despite all the stories of decline, we produce more than Japan, consume more than Europe, and remain the most productive richest nation in the world. Yet maintaining economic preeminence in this changing world will depend upon America's capacity for renewal and upon our ability to finally come to terms with the racial problems that have plagued us throughout our history.[1]

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1. Vernon E. Jordan Jr. "Diversity and American Competitiveness: If the US is to Retain Its position as the World's Economic Leader, It Must Continue Progress in Mainstreaming Minorities in the Workplace." Focus. Vol.19. no. 10. October 1991. p.5.

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Vernon Jordan's plea and any objective evaluation of American national interest should tell us that it makes great sense to develop and exploit the talent and brain power of all Americans including all American minorities. Yet throughout American history that interest has never prevented or outweighed the detours around our national interests caused by irrational fears and racial bias. This will become apparent when we examine what has happened to African American males, especially in comparison to international students, in attaining doctoral degrees from American universities since 1975. It should not be unreasonable to expect for enlightened American universities to at least give American Blacks, including Black American males, opportunities comparable to the opportunities provided to international students.

The dearth of US born and raised African Americans receiving doctorates in the sciences is generally known to be bleak. It might be beneficial to examine just how bleak. You can get this data (by special request) from the Doctoral Research annual survey of U.S. doctoral recipients from the Office of Scientific and Engineering Personnel of the National Research Council of the National Academy of Sciences. In their annual survey they do not break down US born African Americans from other naturalized Americans of color.

In 1990 all American universities produced only 4 US born and raised African Americans (and 5 Puerto Ricans and Mexican Americans) who received doctoral degrees in math compared to 413 non American citizens. In computer science the numbers were 2 African Americans and 2 Puerto Ricans and Mexican Americans compared to 263 non American citizens; there were only 4 US African American and 4 Puerto Rican and no Mexican American Ph.Ds in Physics and Astronomy compared to 511 non American citizen Ph.Ds in those fields; In Earth Atmospheric and Marine Sciences, nationwide there were 2 US African Americans ,5 Puerto Ricans and 3 Mexican Americans compared to 171 non American citizens who received doctorates. Finally let's look at the larger fields of chemistry,engineering and the life sciences. In chemistry 12 US African Americans, 19 Puerto Ricans and 11 Mexican Americans received Ph.Ds compared to 510 non US citizens; in engineering 28 US African Americans,6 Puerto Ricans and 13 Mexican Americans received Ph.Ds compared to 2191 non US citizens; in the life sciences 63 US African Americans 35 Puerto Ricans and 36 Mexican Americans received degrees compared to 1463 non American citizens who received degrees from American universities in these fields.

Dean Frank L. Morris

What is more shocking is the wide number of important scientific fields where American universities produced not a single US African American Ph. D. in 1990. What follows are **some** of those key scientific fields with the number of non American citizen Ph.Ds produced by American universities in parentheses.

There were **no US produced African American** Ph.Ds in applied math (86), algebra (15), number theory (11), topology (16), operations research (16), other and general math (105),astronomy (12),acoustics (8),atomic and molecular physics (25),elementary particles (63),nuclear (24),optics (28), plasma (13), analytical chemistry (51), agricultural and food chemistry,geology (21), geophysics and seismology (29), oceanography (33), civil engineering (258), engineering mechanics (60), industrial engineering (77) materials science (146), nuclear engineering (36), petroleum engineering (24), systems engineering (21), biophysics (37),ecology (19), molecular biology (85),microbiology and bacteriology (77),neurosciences (27), etc. These data come from pages 61 -67 of a special study of the doctoral project with the data about non American citizens coming from their annual report in 1990.

The above data is shocking. We are not even close to a balance between the commitment of American universities to US African Americans compared to international students. Note that in 1990 no US university produced an American Black Ph. D in agricultural and food chemistry in spite of the fact that one of the greatest American scientists who ever lived in the field was a poor US born and bred African American.

Let's look at a comparison between African Americans and International students in the allocation of doctoral degrees earned in American Universities from 1975 until 1990, the last year where complete figures are available. During this time frame the number of non US citizens receiving doctorates increased from 5,870 in 1975 to 9,398 in 1990. This 60% increase in absolute numbers represented an increase in non US citizen doctorates as a percent of all doctorates from 18% in 1975 to 28% in 1990.2

see tables 1 and 2

During this time frame, even though there was an overall more than 10% decline in American citizen doctorates, Asian, Hispanic and even Native American doctorates more than doubled in absolute numbers. White women doctorates increased 45% and even Black women doctorates increased more than 40%. Even a one third

decline in White male doctorate recipients still left white males over represented in receiving doctorates compared to their proportion of the American population. The group which suffered the greatest decline during this period was Black males. **Black American male doctorates declined from 650 in 1975 to 320 in 1990 a decline of more than 50%.**[3]

See figure 1

The statistics are clear. They demonstrate that doctorate degrees for Black males declined more than 50% once the federal government began to cut back on direct assistance. Once American Black doctoral students had to depend upon American universities as the prime source of funding to finance their studies they became much worse off because American universities have chosen to allocate more of their resources to fields where they have admitted and supported foreign students. Ironically much of this university administered support for international students is in the form of research assistantships which permits them to use federal funds from direct or indirectly funded research to discretionary disproportionally fund international students not American minorities.

If there were not a ready availability of foreign students, American universities would have greater incentives to help develop and increase the supply of American students, even possibly American minority students in many science fields. Instead, American university departments and the one DuPont Circle organizations that primarily speak for American education, unanimously supported previsions of changes in the immigration laws of 1990 which will accelerate the recruitment of international scientists and scholars and thus insure that American minorities will continue to be shut out of these academic openings in the future. These are serious charges. Now lets examine some of the evidence.

American university departments do not attribute the dearth of American Black doctoral students to the lack of financial aid. Yet a lot of evidence suggests otherwise. Michael Nettles in his excellent study commissioned by the GRE concluded that the reduction in (federal) financial assistance has had a negative effect on prospective American Black graduate students at both the masters and the doctoral levels. It also may help to explain why more than 60% of both American Black

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3 Ibid. pp. 27-31, 42-43.

and Hispanic graduate students attend graduate school part time.[4] As Nettles puts it...

> Not surprisingly, the period of greatest available financial aid was in the late 1960s and early 1970s. In 1970, for example, twice the number of students received fellowships, scholarships and traineeships as in 1981. During the period from 1970 to 1981, the federal budget for these forms of assistance declined by more than half. The decline has continued. At the same time that grants decreased, student loans increased, going from 717 million in 1976 to nearly 3.5 billion in 1984.[5]

Nettles noted that as federal direct student funding declined students became more dependent upon universities for assistance. He stated that this shift would have profound effects upon the ability of Black students to afford graduate school. That statement by Nettles may have been the understatement of the year. As universities have become the prime determining financing factor for doctoral degrees African American males have fared much worse than anybody else,especially in comparison to international students.

The annual NRC doctoral research project has tracked how those who were successful in achieving the doctorates financed their education. The latest (1990) data is informative. For international students, American Universities were the primary source of doctoral support for 68.8% while for African Americans Universities were the primary source of support for less than 25%.[6] For more than 60% of African Americans (and Native Americans) the primary source of support for their doctoral education was their own personal funds such as loans. In contrast, only 13.8% of international students primarily depended on personal funds to finance their doctoral education.

See tables 3.4.5.

American universities and the doctoral research project of the NRC try to explain away the above by contending that minorities including African American males are in fields that less university and federal support is available. That is a partial explanation. Yet it does not explain why Hispanics and Native Americans and even Black women

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4. Michael Nettles, Financial Aid and Minority Participation in Graduate Education, A research report of the Minority Graduate Education Project, Educational Testing Service, Princeton,1987, pp. 1,5.
5. Ibid, p. 5

6 The data for these comparisons come from NRC 90, tables 12 and S-7, pages 24 and 47.

who get doctorates in similar fields as Black males were almost able to double their doctoral production between 1975 and 1990. It does not also explain why American university departments did not recruit more minorities in fields where they had discretionary financing.

The different fields lie is even more apparent if we compare the fields where a much higher proportion of American minority students than international students are found. In education doctorates,where many minorities are found, I found the following. For American Blacks who received their degree in education in 1990, 81% listed personal resources as the prime source of financing for their doctoral studies and only 12% were primarily funded by American universities. In contrast, international students who received doctorates in education that year only 41% listed personal resources as their primary source of funding and more than 28% were primarily funded by American universities. Keep in mind that the absolute number of international students is many times greater than African Americans or all American minorities combined so a large positive funding percentage in favor of international students translates into almost geometric differences in actual funding differences.

Thus if we just look in the doctoral field where about one half of all African Americans achieve their doctorates, twice the proportion of American Blacks as non American citizens had to personally finance their doctoral educations. Equally important **American universities were more than twice as likely to provide funds to international students in education as American Blacks.**[7]

See Table 6

We find similar patterns in fields such as the social sciences and the humanities. In the social sciences, almost half (48.5)1990 American Black Ph.Ds financed their education by personal funds while only (22.5%) of international students had to pay for their education with personal funds. American universities were the prime source of financing for 37% of American Black Ph.Ds while universities were the prime source of funding for 56% of international student Ph.Ds.[8]

It is difficult to understand why American universities should favor non American citizens in the humanities but they do. Only 28% of international doctoral students in the humanities primarily used personal funds to finance their doctoral studies compared to 50% of American Black doctoral students. Universities were the primary

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7 . Ibid

8 Ibid.

source of support for almost 57% of international students in 1990 compared to only 50% of American Black doctoral students. Remember these figures are for those who successfully completed their doctorates!

The difference of fields justification should be finally put to rest because (university) support for American Black male doctoral education declined as American Black doctorates increased in the breadth of fields. In spite of an overall decline, American Black doctorates in engineering, life sciences, social sciences and in professional fields increased and the percentage in education decreased. Education doctorates as a percentage of all American Black doctorates declined from almost 61% in 1975 to a little more than 50% in 1990.

It is important to also point out that while American universities were giving preferential doctoral financing to international doctoral students over American doctoral students in education, African American and Hispanic doctoral awardees in education were accumulating significant graduate debt to go with high undergraduate debt. One third of all Hispanic doctoral awardees and more than one quarter of the American Black awardees reported debt of more than $10,000 thanks in part to the preferences of university deans and graduate schools[9]. Keep in mind that this high debt is in a field where the salaries are lower than in the sciences.

There are other indicators which show a preference or bias of American university graduate departments toward international students over American minorities especially in comparison with American Blacks and Native Americans. In both real and total time to complete the degree international students appear to have the advantage over American Blacks and Hispanics. In education for example, the median total time for non citizen international students was 12.8 years compared to 19.6 years for American Blacks and 16.4 years for Hispanics. The real time median differentials were 6.1 years for international students in education compared to 8.5 years for both American Black and Hispanic doctoral degree recipients.[10] Part of this difference could be related to the preference of international students for university support for research assistantships. Research assistantships encourage interaction with faculty,promote the possibility of both mentoring and possibly provide a basis for a dissertation.

In spite of the above, American universities contend that factors other than their differential allocation of financial aid account for the dearth of minorities in graduate education. This is in spite of the fact

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9 Ibid.

10 . Ibid. table 6, page 15;Table S-6 , page 46.

that Nettles and others pointed out years ago that the much lower median family income and the extreme difference in black and white family wealth in the US requires that minority students especially American Blacks, non Cuban Hispanics and Native Americans, assume much greater undergraduate debt burdens than White American graduate students. Nettles strongly suggests that this differential debt burden affect minority and majority students differently when they make education and career decisions.[11] It is an entirely rational decision not to go on to doctoral degree programs when you see that the majority of your peers who do are not favored in comparison with international students and students of your race are forced to take longer to complete your degrees?

Another contention of American universities is that there is a "pipeline" problem which keeps them from finding "qualified" American black graduate students. This contention seems to have less merit on its face after we have examined the American university funding preferences for international students mentioned above. Yet the NRC report notes that such "qualified" potentially successful American Black graduate students are disproportionally located on the campuses of historically Black colleges and universities. Although such colleges and universities enroll only about 16% of all Black students in American higher education,they were the baccalaureate-granting school for almost 60% of the American Blacks who received their Ph.D degrees in 1975 and almost 40% of the American Blacks who received their Ph.Ds in 1990.[12] I am proud to teach an work on one such campus which produces more Black Ph.Ds than any other public American university according to the latest figures. Yet I do not see American universities actively try to extensively recruit or offer to support our American Black science graduates who have the capability to succeed in doctoral programs. So much for the alleged pipeline problem.

There is another more sinister effect of giving international students financial aid preference over American minorities. In 1975 68% of American Black doctoral recipients found academic employment in US universities compared with only 52% of the international doctoral degree recipients that year. In 1990 after the number of academic jobs have declined we find that only 55.8% of the 1990 Black American cohort found academic jobs compared to 56% of non American citizens who were snapped up by American academic institutions[13].

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11 Nettles, P.4.

12 NRC Report 1990 P. 32

13 Ibid. Table 6. Page 15, Table S-6, Page 46.

Keep in mind that in 1990 international students received more than four times as many doctorates from American universities than all American minorities combined. There clearly seems to be a move afoot to freeze out American minorities, especially Black American males from future faculty positions. Black Americans resent this process even more when we see American universities recruit international scholars of color and then label them as "minority" rather than more accurately as international faculty.

Now lets really see why there is this overwhelming preference in American graduate university departments for international students and especially international Asian students in the sciences. Three countries provided 44% of all non American citizen doctorates in 1990 specifically Korea and the two Chinas.[14] This is consistent with the current Asian American stereotype of the "model minority" who is an insatiable docile and compliant worker.

It is therefore important to record for the record that the one DuPont Circle organizations who represent American universities worked and testified in support of the 1990 immigration law changes to make it much easier for foreign professors and students to get both access to and permanent status in the US. This trend, which clearly works to the detriment of US minorities is likely to accelerate in the future. In a paper read at last Spring's Northeast Association of Graduate Schools meeting, David Simcox, Executive Director of the Center for Immigration Studies, a Washington DC immigration think tank put it as follows:

> Several things work to increase immigration in the 90s the most obvious one is rapid population growth in the third world, particularly among the young, highly mobile working age population. Much of the third world is falling behind in the race to create new jobs to match the growth of their labor forces. The labor force of Mexico will grow by about one million a year but Mexico's economy will create less than half that number of new jobs.
>
> The International Labor Organization estimates the labor force to grow in the third world by 50 million per year of which, less than half, can be absorbed in their economies. These economies are also not having success in finding jobs for the increasing number of college graduates they produce.
>
> Indeed we are seeing higher education priorities in some major sending countries such as India, Pakistan, Korea

[14] Ibid., Table 4 Page 11.

> and the Philippines increasingly determined by the demand for skills and training that are marketable in the west... thus India produces more doctors ands engineers and the Philippines more nurses each year than their economies can effectively absorb. This further expands the pool of educated candidates for graduate education or faculty positions in US universities.
>
> A greater percentage of foreign students will chose careers in the sciences because those disciplines are viewed as culturally neutral; because US universities are still considered as the best in science and technology; and last but not least, the transition to permanent residence in the US is easiest for those with science skills.[15]

We must be careful not to kid ourselves. How many of you as graduate deans really believe that your university departments in the sciences would really prefer to have more African American males in their departments. This is especially the case in determining whether they are more comfortable with African American males in comparison with any international student or even any other American minority. Dr. Richard Majors, a Harvard trained scholar at the University of Wisconsin, Eau Claire puts it this way in explaining the perceived threat of young Black males.

> White people often look at the expressive lifestyles of Black males as threatening, aggressive and intimidating, which is the reason Black boys are suspended more frequently and for longer periods of time, and are more likely to be assigned to remedial courses and classes for the retarded and learning disabled. Also the disproportionate drop out rate or push out rate is due in large part to cultural misinterpretation of these behaviors.[16]

I believe that the irrational fears that impact American Black males at the elementary and secondary level are reflected in increased discomfort levels of the predominantly white American males who control the key access processes which result in the clear preferences

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15 David Simcox. Immigration in the 1990s and Graduate Education. Paper given at the annual conference of the Northeast Association of Graduate Schools.

16 Ed Wiley III. "Cool Posing: Misinterpreted Expressions Often Lead to Educational Deprivation." Black Issues in Higher Education. Vol. 7 No. 19, Nov.22,1990.

of international students over our minority students,especially our African American males.

I am not one to simply point out the problems without the solution of what you as graduate deans can do to change things. That will be the final section of this paper.

What Graduate Deans Can Do

Graduate deans should not deny that there is a need to address such a great imbalance in favor of international students over American minorities in graduate education. International students received 28% of all doctorates given by American Universities in 1990. Note how this compares with African American males. African American males are 7% of the U.S. population. Yet they are 47% of the US prison population, 5% of the top jobs in corporate America but only 3% of the US college population and even worse only less than 1% of those who received doctorates from American universities in 1990. How do we and you justify the American private corporate sector doing much better than our universities? Let's now focus on what can be done.

The first thing a graduate dean should do if you are concerned about the lack of minorities on your campus is to examine and document the extent of the underrepresentation. You should not hesitate to point out to departments how their commitment to international students compares with their commitment to American minorities. Deans should be especially sensitive to categories of minorities such as native Americans, African Americans (especially African American males) and specific Latino sub populations such as Puerto Ricans and Mexican Americans. Your discussion with departments and schools should not only be about minorities and women in general but specifically about the most underrepresented minorities and the reasons for their non presence.

Graduate deans have a responsibility to question department and school practices which give greater preferences to international students rather than to American minorities. We should be especially vigilant in monitoring the dire situation of US born African American males. It may take great powers of persuasion because many American academics may feel more uncomfortable with an increased presence of African Americans (especially African American males) because of the relatively recent past racial tensions on many American university campuses including the Universities of Michigan and Massachusetts and numerous others. Graduate deans should be willing to confront departments and schools whenever the imbalances are as great as those pointed out above.

Dean Frank L. Morris

MORGAN STATE UNIVERSITY

Graduate deans often have responsibility for or influence over graduate school financial aid. You should explore on your campus to see if there are American minority/international student imbalances and whether the imbalances are the result of conscious or unconscious prejudices or bias. You should be skeptical of and question departments when they rarely select American minorities or specifically African American males for either admission or if admitted, rarely give them research assistantships.

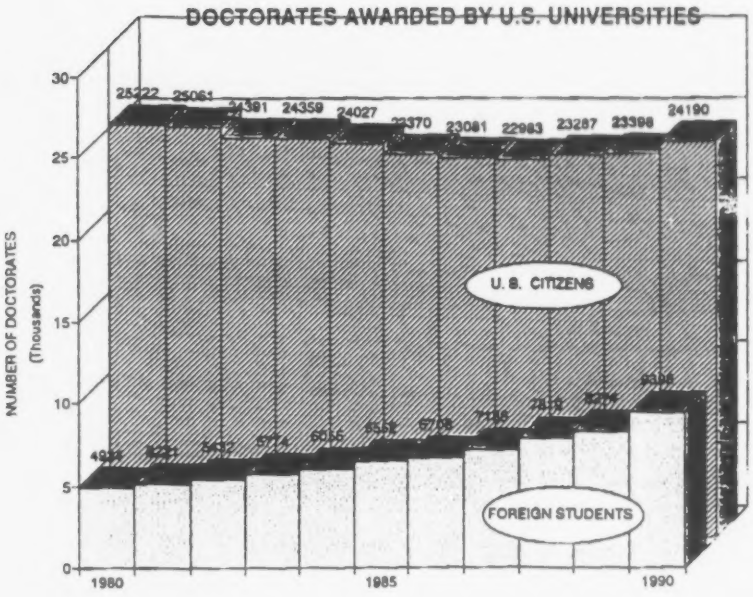
One of the factors that leads to less financial assistance to American minorities is when American universities heavily rely upon standardized tests in the determination which doctoral students get financial aid. If departments heavily rely upon standardized tests in the allocation of financial aid, you can rest assure that they give a low priority to either diversity or a fair shake for American minorities. The alternative standard could be whether the past records, especially their GPA and recommendations, indicate that the student could be successful in the program. If there are doubts about minority students departments should be willing to interview them.

The best way to recruit American minorities is through faculty contacts. This includes faculty to faculty contacts in departments where a large number of minorities are undergraduates. This often means extensive communications and contacts with Historically Black institutions or departments located in comprehensive universities in large cities. If your departments are not doing this then you should know that they have no intention of diversifying their doctoral students with American minorities.

In upholding standards and providing certification, graduate deans have found that the job most requires that we provide vision, motivate and most important, persuade others to do the right thing. Any student of American history knows than nothing is more difficult than changing American values and actions that involve the issue of race. Unfortunately it seems that nothing is more difficult than changing American values and actions that involve race. Unfortunately it seems that this will be our main American challenge of the 21st century as it has been our main domestic challenge of the 19th and 20th. Good luck!

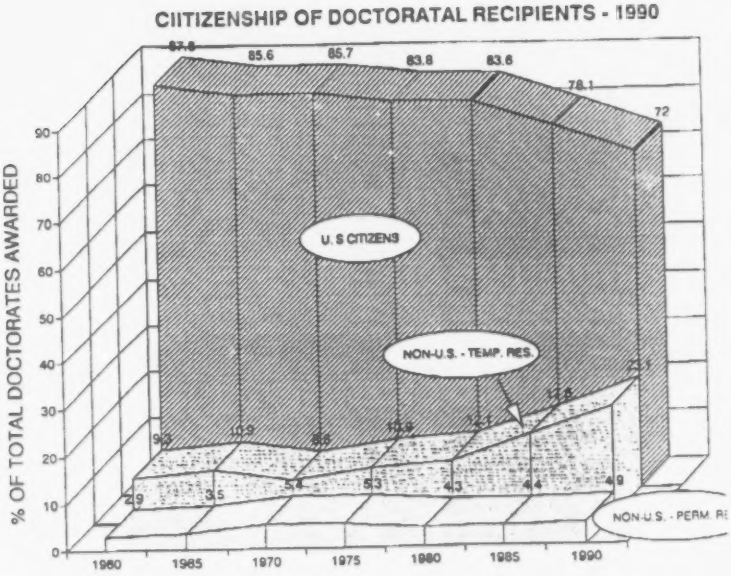
Dean Frank L. Morris

TABLE 1



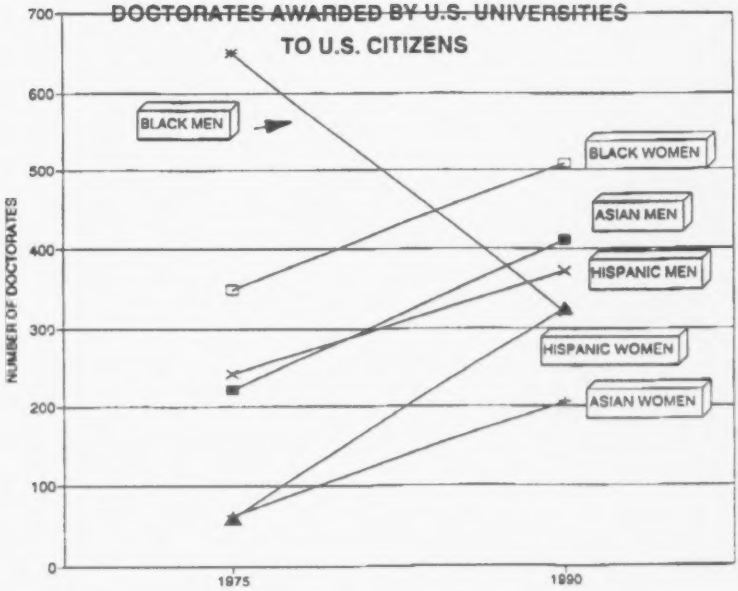
Thurgood. D.H., and J.M. Weinman. 1991. *Summary Report 1990: Doctorate Recipients from United States Universities*. Washington, D.C. National Advisory Press. Table prepared by Office of Institutional Planning and Evaluation, Morgan State University.

TABLE 2



Thurgood. D.H., and J.M. Weinman. 1991. *Summary Report 1990: Doctorate Recipients from United States Universities*. Washington, D.C. National Advisory Press. Table prepared by Office of Institutional Planning and Evaluation, Morgan State University.

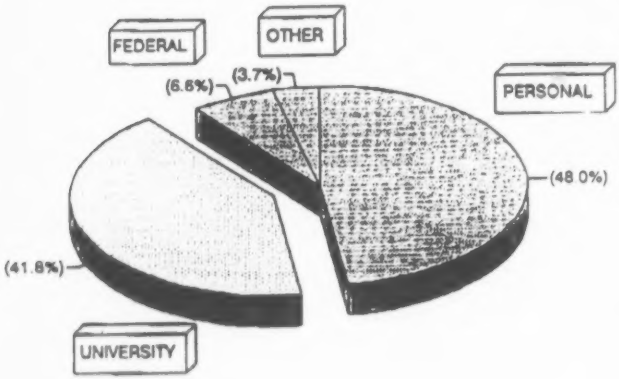
FIGURE 1



Thurgood, D.H., and J.M. Weinman. 1991. *Summary Report 1990: Doctorate Recipients from United States Universities.* Washington, D.C. National Advisory Press. Table prepared by Office of Institutional Planning and Evaluation, Morgan State University.

TABLE 3

SOURCES OF SUPPORT FOR 1990 DOCTORAL RECIPIENTS
ALL U.S. CITIZENS

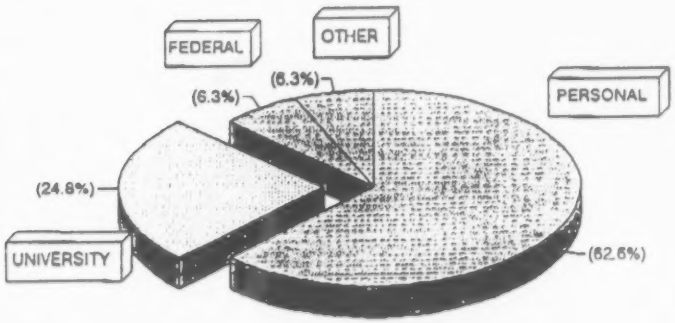


Thurgood. D.H., and J.M. Weinman. 1991. *Summary Report 1990: Doctorate Recipients from United States Universities.* Washington, D.C. National Advisory Press. Table prepared by Office of Institutional Planning and Evaluation, Morgan State University.

TABLE 4

SOURCES OF SUPPORT FOR 1990 DOCTORAL RECIPIENTS

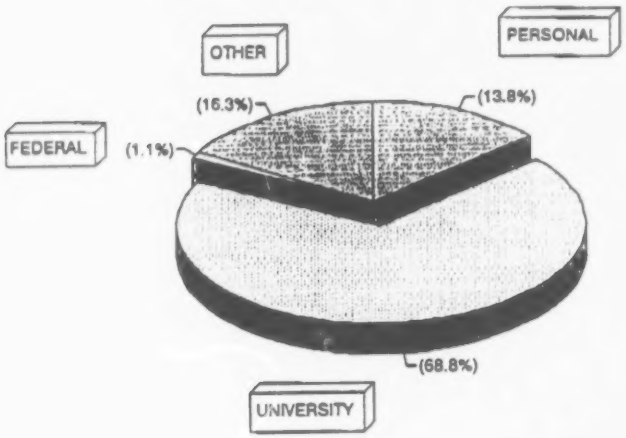
AFRICAN-AMERICANS



Thurgood. D.H., and J.M. Weinman. 1991. *Summary Report 1990: Doctorate Recipients from United States Universities.* Washington. D.C. National Advisory Press. Table prepared by Office of Institutional Planning and Evaluation. Morgan State University.

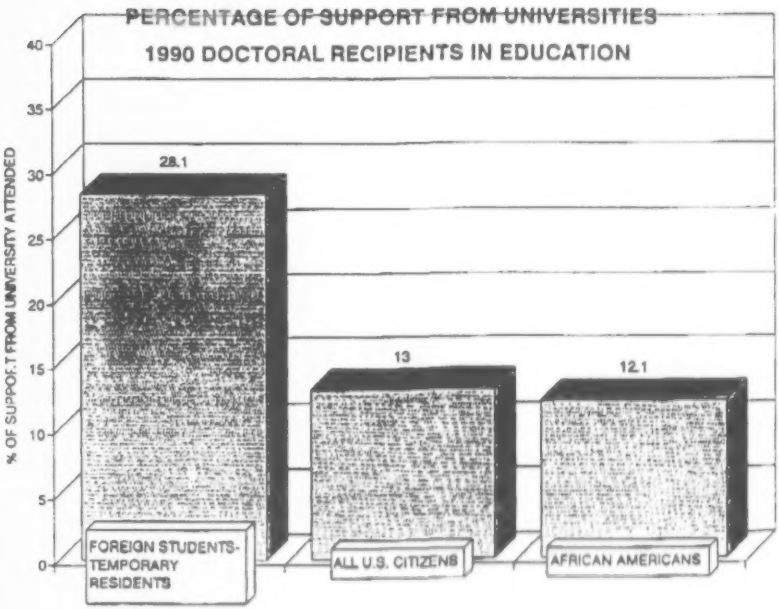
TABLE 5

SOURCES OF SUPPORT FOR 1990 DOCTORAL RECIPIENTS
FOREIGN STUDENTS - TEMPORARY RESIDENTS

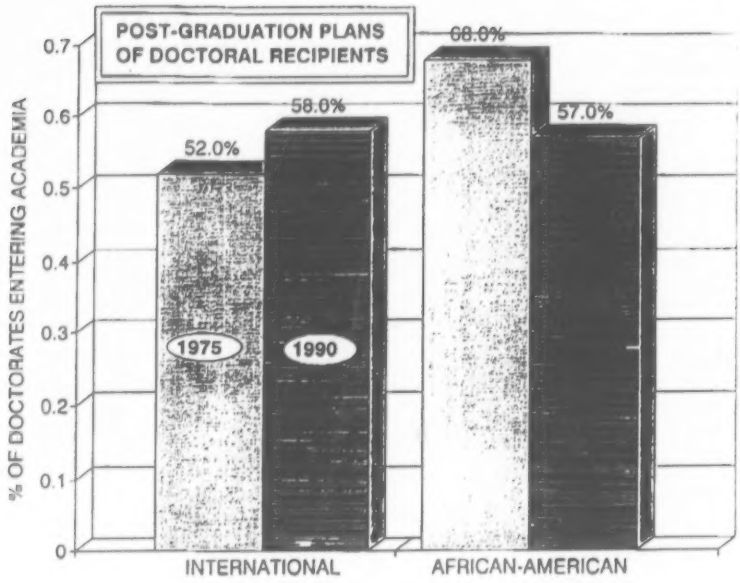


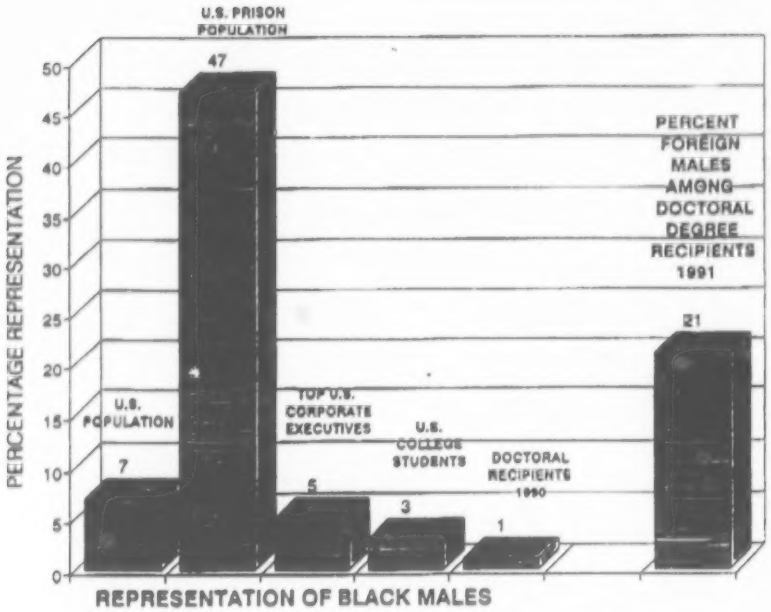
Thurgood. D.H., and J.M. Weinman. 1991. *Summary Report 1990: Doctorate Recipients from United States Universities*. Washington. D.C. National Advisory Press. Table prepared by Office of Insututional Planning and Evaluation. Morgan State University.

TABLE 6



Thurgood, D.H., and J.M. Weinman. 1991. *Summary Report 1990: Doctorate Recipients from United States Universities*. Washington, D.C. National Advisory Press. Table prepared by Office of Institutional Planning and Evaluation, Morgan State University.


POST-GRADUATION PLANS
OF DOCTORAL RECIPIENTS
% OF DOCTORATES ENTERING ACADEMIA
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
52.0%
58.0%
68.0%
57.0%
1975
1990
INTERNATIONAL
AFRICAN-AMERICAN


U.S. PRISON POPULATION
47
PERCENTAGE REPRESENTATION
50
45
40
35
30
25
20
15
10
5
0
U.S. POPULATION
7
TOP U.S. CORPORATE EXECUTIVES
5
U.S. COLLEGE STUDENTS
3
DOCTORAL RECIPIENTS 1990
1
PERCENT FOREIGN MALES AMONG DOCTORAL DEGREE RECIPIENTS 1991
21
REPRESENTATION OF BLACK MALES

42 Maple Street
Auburndale, MA 02166
April 26, 1992

Congressman Paul Henry
215 Cannon House Office Building
U. S.. House of Representatives
Washington, DC 20515

Dear Congressman Henry,

Enclosed is material I would like to offer for inclusion as written testimony in support of H.R. 4595. Due to the short time I have had, there was not time to get organizational approval for my position paper, but I have asked the IEEE to support your bill. Mr. Vin O'Neill (202-785-0017) can provide you information about what they plan to do. Our President, Merrill Buckley has been informed about the bill by Bob Filka.

I would expect intense opposition to your bill by the educational establishment. They have a good system working for them and do not welcome any changes: The academic institutions and the National Science Foundation have a mutually supportive system in place and they will fight to keep the current rules in place.

Unfortunately, I have no one funding my efforts. For that reason, I can not come to Washington for your hearing. The opposition should be expected to spend considerable effort and money to defeat your bill.

A recent hearing by Representative Howard Wolpe showed that the NSF projections of a serious shortage of scientists and engineers was based on flawed research. The NSF and university system have used the study to mislead young people about the opportunities in science and engineering. Many feel this coalition deliberately misinformed the nation, the Congress, and the young people of our country. Realize that this is the same group that you are opposing with your bill.

Would you please send me a copy of the hearing record.

Sincerely,

John P. Densler

EDUCATION OR EXPLOITATION

I am presenting testimony as an individual whom after the age of 50 decided to go back to school and to begin a doctorate. When I saw what was happening in academic institutions, the ethics disturbed me. I decided after an investment of about two years time that further efforts were not worth the potential reward. My experience has convinced me that we the taxpayers are supporting the exploitation of alien students. We are creating a condition of indentured servitude under the disguise of education!

The evidence is that the present system we have for educating graduate students, especially at a doctoral level in science and engineering has as a systems effect, the systematic exploitation of foreign graduate students. Their status is no different from indentured servants. Some of you may wonder why I would make this charge. It is the effect of a system that has inherent preferences. To function it needs hard working low paid workers, willing to put up with poor working conditions without complaint.

Professors must perform research to receive tenure and promotion. The research also must be published. Tenure is granted on the basis of the number of papers published. Most of this research in science and engineering is supported by federal and foundation grants.

A professor has an incentive to get the most work for the funds he or she has received through each grant. In practice most of the work is done by graduate students under the direction of the professor. This is especially true in the case of foreign students working on doctoral degrees. The professor has the power to make the doctoral thesis work take as long as desired. The foreign student, especially if he or she comes from a third world country little choice but to submit or go back to a homeland where there may be little chance for professional success. Usually the research is reported as a paper jointly authored by the professor and the graduate student. By employing several graduate students, the "Quota" number of papers can be published.

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EDUCATION OR EXPLOITATION

The professor is frequently measured on the ability to produce research funding for the department. Given this system, the professor will get more research for the grant dollar by hiring a foreign student over a citizen. This practice has been institutionalized by the systematic recruiting of foreign students by the top universities, but also the lesser known institutions. The schools have a capacity in place and it is in their best interest to fill that capacity, even if citizens are not interested in the field. Young PhD physics graduates recently have been complaining about the lack of opportunities, yet many professors still maintain there is shortage. The president of the American Association for the Advancement of Science, Dr. Leon Lenderman is quoted as saying, "The opportunities for scientists in general are tremendous."[1] This is at a time when a single teaching position at Amherst resulted in 813 applications.

If the student submits to the "System" eventually a doctorate is received. Submitting may mean working 90 or more hours per week on research to please the professor. This may continue for up to eight or more years. When economic conditions are unfavorable as they now are, post doctoral fellowships must be endured before professional employment is possible at a professional salary level.[1] (Figure 1)

No where in this system, does the concept of a minimum wage apply or even the generally accepted rights for fair treatment. In some state universities, graduate students have begun to unionize because of their poor treatment.

What are the net effects of this system? In science and engineering fewer and fewer talented US citizens choose to study for higher degrees in science and engineering. The rewards are not worth the effort and financial sacrifice involved in the pursuit of the advanced degrees. For the foreign student, the economics are very different! The potential exists to get eventually US citizenship if the conditions are tolerated by the individual. Some universities even use the lure of US citizenship

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1 New York Times-Science Section, Tuesday March 10, 1992

to recruit foreign students. They use the opportunity to study as a means to bypass the usual immigration limits. There is no limit on the number of F-1 visas allowed. One has only to look at the composition of the junior US faculties in engineering and science to see this principle in action. Universities do not have the same labor certification requirements as industry in the hiring of aliens for faculty positions.

What is happening is no different than Gresham's Law in economics. The low price workers will eventually drive out the higher priced workers. This principle works in coins as well as with people.

Another effect is to favor the hiring of foreign students over women and minority students from our country. Why should our taxpayers be supporting aliens and not deserving disadvantaged citizens?

There is even a more serious economic issue. Foreign students learn the frontiers of high technology and have the choice to take that technology back to their home countries. In southeast asia, specifically Taiwan, Korea, and Singapore, foreign governments and companies are willing to pay attractive salaries for people with science and engineering experience from this country. Many times this experience has been funded by you and I, the taxpayer.

We are in effect subsidizing our competitors in world trade. This is not a new concept. At MIT as one example, the taxpayer supports a number of science and engineering related programs. MIT allows any company, including the Japanese Ministries access to this technology under the Industrial Liaison Program. For a reasonable fee, any foreign company can have access to research supported by the US taxpayer! The company can even have its employees come here and work on sponsored research. In exchange, it will get all the information needed to compete with our companies.

John Densler April 26, 1992
3 Attachments

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The New York Times - Science Section
Tuesday, March 10, 1992

Amid 'Shortage,' Young Physicists See Few Jobs

By MALCOLM W. BROWNE

EVEN as leading scientists warn that America's educational system is failing to produce scientists fast enough to fill a glaring projected shortage, many young physicists contend that universities are already turning out far more physicists than there are permanent jobs.

If the job market for research physicists does not radically improve soon, they say, growing numbers of gifted young Americans will be turned away from careers in physics, a field deemed by many experts as vital to maintaining America's technological and economic health.

Permanent research jobs for young physicists have virtually dried up, partly because the recession has drastically undercut the resources of universities and commercial research institutions. In addition, physicists in senior faculty and research positions who had been expected to retire in large numbers in recent years have not done so. At the same time, a growing tide of physicists immigrating from the former Soviet Union and eastern Europe has begun to exacerbate the glut of American physicists.

The situation was underscored last month when Dr. Robert Hilborn, chairman of the physics department at Amherst College, disclosed that 813 physicists had applied for a single job on the college's physics faculty. About three-quarters were recent recipients of doctoral degrees, while some 200 were experienced physicists, including about 60 from the former Soviet Union.

Few young physicists are completely out of work, but many are in temporary postdoctoral positions with low salaries, poor prospects of advancement, and no job security. Many are deeply dissatisfied.

Senior physicists, labeled by many younger ones as "the establishment," contend that an advanced degree in physics is an excellent education, even if it leads to no job. Besides, physicists are at the pinnacle of science, they argue, and superbly qualified to take jobs as applied scientists, engineers or even plumbers.

But young physicists say that even in industry there are all too few jobs available because of the recession and changing industrial research goals. Major commercial laboratories that once employed many full-time scientists now prefer postdoctoral students working as temporary employees.

Despite the scarcity of permanent jobs for starting-level physicists, most science analysts believe the nation will face a dangerous shortage of physicists in the next century.

Anger Among Young Physicists

But many young physicists were angered by a prediction last year from the National Science Foundation that the United States would have a shortage of 625,000 scientists in two decades. The prediction, say many young physicists, was wildly inaccurate and self-serving, intended mainly to nudge Congress into providing more financing for the agency.

Although junior physicists have no formal organization, an informal "Young Scientists Network" was recently founded by Dr. Kevin D. Aylesworth, a postdoctoral fellow at the Naval Research Laboratory in Washington. His information exchange now includes several hundred postdoctoral physicists.

"Established senior physicists simply aren't listening to us postdocs," he said in an interview. "They're too busy finding money for their own institutions and projects. Conditions for us are not what they were when establishment scientists were young. The way things look now, I doubt that there ever will be a shortage of scientists anywhere near as severe as the N.S.F. forecast."

A stream of letters published by the professional magazine Physics Today has echoed Dr. Aylesworth's opinion. "I remain extremely skeptical about the impending Ph.D. shortage that is supposed to occur when large numbers of present faculty members retire," wrote Dr. Robert L. Yates of Lexington, Ky. Senior faculty members are postponing retirement, he said, and even those who do retire are sometimes not replaced.

> A few embittered physicists say education in their field is pointless.

'Chilling Stories'

A few young physicists are so embittered by the slack job market that they believe physics education is pointless.

"The only thing clear is that there are fewer jobs for physicists because there is less economic need for physicists," Murray Arnow of Skokie, Ill., wrote in a letter to Physics Today. "The current commitment by the American Physical Society to promote science education is almost fully given the declining demand for physicists."

Dr. Kate Kirby, an atomic physicist with the Harvard-Smithsonian Center for Astrophysics and chairwoman of the American Physical Society's membership committee, said: "We constantly hear chilling stories. We know of gifted postdoctoral physicists who have held temporary postdoc jobs for seven years or so before reaching the lowest rung of the academic tenure track."

Challenge to Gloomy Outlook

This gloomy view is strongly challenged by Dr. Leon M. Lederman, a Nobel laureate in physics and the president of the American Association for the Advancement of Science.

"The opportunities for scientists in general are tremendous," he said. "A physicist may not always find opportunity in his original narrow research specialty, but only 2 or 3 percent of physicists are actually unemployed. The need for scientists to contribute to the defense of the environment is growing, and physicists will also star in the quest for alternative energy sources and many other social needs. There's no question that the nation will need more physicists."

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The New York Times - Science Section
Tuesday, March 10, 1992 - (continued)

Far from cutting back science education, Dr. Lederman says, the nation must enhance it at every level, and to that end he has organized a group of volunteer scientists who tutor Chicago-area school teachers in the teaching of science.

But Dr. Lederman and other leading scientists acknowledge that many physics research positions in industry have disappeared because of the recession.

Cutbacks at Laboratories

The trend is evident, for example, at A.T.&T. Bell Laboratories, one of the world's preeminent institutions of physics research whose employees have garnered many Nobel Prizes. The company now employs 172 physicists as permanent staff members and 104 postdoctoral fellows. Very few of the latter group stand a chance of getting permanent jobs with the laboratory, says Dr. Arno Penzias, the laboratory's vice president for research, who is a Nobel laureate himself. On the other hand, Dr. Penzias said, the training postdoctoral fellows receive at the laboratory prepares them for a wide range of physics specialties.

This trend away from pure research has induced some prominent physicists to leave industrial laboratories for academic positions, a shift that has made academic jobs for young physicists even more scarce.

Dr. Charles V. Shank, director of Lawrence Berkeley Laboratory, worked for 20 years at Bell Laboratories, the predecessor of A.T.&T. Bell Laboratories, before deciding to leave. "It's a very competitive world, and A.T.&T. Bell simply felt that it needed research more closely connected to its near-term business interests than was the case in the past," he said.

A would-be scientist who embarks on a career in physics faces more uncertainties than young scientists in other fields, experts agree. A physicist must complete a doctorate and one or two postdoctoral appointments, usually of two years each, before even becoming eligible to look for an academic job. It is a course of study taking roughly the equivalent time to that needed to become a medical doctor, which is generally much better paid. By contrast, a chemist with only a bachelor's or master's degree can usually find a job in the field, although holders of doctoral degrees command higher salaries.

More Physicists Each Year

Suzanne Ellis, educational studies analyst for the American Institute of Physics, said the average postdoctoral fellow in physics draws a salary of about $30,000, and may have to forgo permanent employment for years. Moreover, she said, more physicists enter the system each year. In 1982, for instance, only 912 doctoral degrees in physics were granted in the United States, while in 1989 there were 1,112 and in 1990 there were 1,183.

"The job shortage these days has its roots in the 1980's, when young physicists began preparing for jobs they expected to be vacated by retirements in the early 1990's," Mrs. Ellis said. "Instead, the senior physicists are not retiring."

In 1990, she said, 12 percent of all physicists with recent doctorates seeking positions received no job offer at all, and 50 percent received only one. In 1989, the comparable figures were 7 percent and 45 percent.

In the last three years, some 40 percent of the new United States doctorates in physics went to foreign students, and this has caused some complaints.

Immigration Policy Criticized

Dr. Aylesworth, while not criticizing the presence of foreign physicists in the United States, believes that Congress seriously overestimated the job market for scientists when it passed the Immigration Reform Act of 1989.

Some scientists and engineers are more harshly critical of immigration policies. Merrill W. Buckley, president-elect of the Institute of Electrical and Electronic Engineers, said last month that immigration of foreign engineers should be curbed in times of high unemployment. "We should be as generous as we can, but we have our own self-interest, from a business and professional point of view," he said in a speech before the Information Technology Association of America.

Few senior physicists agree with this point of view. "Without the foreign physicists who came to the United States during this century, American science would have been in a sorry state," said Dr. Robert C. Dynes, professor of physics at the University of California at San Diego.

But many agree that the current crop of young physicists faces some unusual problems. "The generation born in the 1950's was drawn to physics during the heady post-Sputnik era, when Federal money was pouring into the field," said Dr. Robert L. Park of the American Physical Society. "Now, that population bubble from the 1950's is going through the system, just when the job market is worst. The grim truth is that for the next five years the good jobs in physics research will be hard to come by. They could become a lost generation." Dr. Park said. "Even worse will be the loss to the nation of all that scientific talent."

Graduates' Employment Status

The overwhelming majority of physics graduates who said they had [illegible] and jobs [illegible] computing [illegible] requirements, in a [illegible] after [illegible] degrees.

	Employed in physics	Employed in other fields	Unemployed	Percentage of physics graduates who said they had jobs requiring physics knowledge
1981	67%			81%
1982				81
1983	68			81
1984	71			78
1985	70			86
1986	72			82
1987	72			79
1988	71			85
1989	73			85
1990	76			85

Source: American Institute of Physics

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The Washington Post

FINAL

Scientist Shortfall a Myth

NSF Study Seriously Flawed, Panel Is Told

By Boyce Rensberger
Washington Post Staff Writer

The familiar claim that the United States faces a major shortage of scientists and engineers—often cited by National Science Foundation officials when seeking budget increases—is false and was based on a seriously flawed NSF study, seven scientists, engineers and government officials told a congressional subcommittee yesterday.

The NSF warning was so widely repeated during the late 1980s—especially by Erich Bloch, who then headed the agency, in scores of public speeches and congressional appearances—that it became part of the conventional wisdom. Educators bemoaned the decline in the number of young Americans entering science. Scientific societies launched major programs to attract more students into scientific careers. And almost everyone blamed the presumed shortage for declining American competitiveness in the world economy.

In fact, witnesses told the hearing, the shortage that was to have begun a few years ago—and which was to have left the nation with a "shortfall" of 675,000 scientists and engineers by 2010—never materialized. Quite the contrary, they said, there is now such a surplus of

See SCIENCE, A8, Col. 1

SCIENCE, From A1

scientists and engineers that unemployment rates in some disciplines far exceed those for the country as a whole and typical salaries for beginning PhDs in many fields are $18,000 to $25,000.

The NSF official who did the study, Peter House, defended it by telling the committee he merely sought to depict a hypothetical situation. He said the study was never intended as a forecast of what might happen in the real world.

Still, said Rep. Howard Wolpe (D-Mich.), chairman of the subcommittee on investigations and oversight of the House Committee on Science, Space and Technology, Bloch used the flawed study to get higher appropriations for NSF.

"No one expects the NSF to play that game," Wolpe said. "This was not good science. . . . [It] has tarnished NSF's image."

The NSF, with a budget of $2.4 billion, funds most of this country's nonmedical, nonmilitary basic research.

House of NSF's Policy and Research Analysis Division, did the "shortage" study by "calculating the average number of bachelor's degrees in science and engineering granted annually from 1984 through 1986, which came to about 211,000 a year. House told the subcommittee he assumed that 211,000 was the number of scientists and engineers that American society would demand each year thereafter.

REP. HOWARD WOLPE
"this was not good science"

House then calculated that the supply would decline significantly thereafter because of the post Baby Boom bust, in which the number of college students across the board would decline—which has happened. The years 1985 and 1986 were the latest peak of a curve that has risen and fallen many times. In 1990 the number of science and engineering degrees had fallen to about 178,000, a "shortfall" in House's calculations of about 33,000 for that year alone.

House's methods met with considerable criticism both outside and inside NSF. For example, the agency's Office of Legislative and Public Affairs refused to approve the study for formal publication as an NSF document. Much of the criticism focused on what was said to be the highly unusual notion of using a peak period of past supply as a measure of future demand.

The study "can't be taken as serious scientific work," said Richard A. Ellis, director of manpower studies for the American Association of Engineering Societies. House's methods, he said, "ignore standard forecasting practices."

Jon Wells of the General Accounting Office told the subcommittee that while NSF said it had asked nine experts, seven of them outside the agency, to review the study, eight of those experts subsequently told the GAO they had not given NSF any comments and the ninth could not remember.

House said his purpose in making the study simple was to inform policy makers, not to influence policy, but that the study's significance was misunderstood. When Wolpe asked him if he ever told Bloch or anyone else that they were misusing his study, House said he had not.

House told the panel that he was unaware his study had had any impact, whereupon Wolpe cited a book House co-wrote—"The Practice of Policy Analysis"—which says the study "became a factor in federal policy toward education of scientists and engineers. It was presented to congressional committees, the national academies and professional groups, and was requested by university administrators all over the country."

Under exasperated questioning by Wolpe, House allowed that some of his written versions of the study failed to make clear that the study was only a hypothetical example and should not be taken as a forecast of what would happen in the real world.

Although NSF never officially published House's study, it was circulated as computer printouts that were run off and then distributed.

According to Wolpe's staff, Bloch gave at least 55 speeches from 1987 through 1990 decrying a coming shortage of scientists that he said would not be able to meet national demand.

Bloch, who was not at the hearing, said in a telephone interview that his speeches referred only to a shortfall as compared to the number of scientists and engineers produced in the peak years of the mid-1980s. "I never said there would be an unsatisfied future demand," Bloch said. "It was not a supply demand study, just a study on the supply."

Bloch left NSF at the end of his term in 1990 and was succeeded by Walter E. Massey. While not explicitly repudiating the House study, Massey told the subcommittee that he was instituting internal procedures to prevent recurrence of such episodes.

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DAVID WARSH

The PhD glut is not like a butter mountain

WHAT COULD BE MORE intimidating than to be a young statistician – or a mathematician, or a physicist – about to graduate and go looking for a job?

Not only is the growth rate of federal funding slowing down. Not only are demographic forces shrinking the pool of available academic jobs. Not only are defense and aerospace workers coming on to the market in significant numbers.

But also a deluge of well-trained refugees from Russia and Eastern Europe are seeking to flood the American market.

But don't expect these scientists to be driving cabs – at least not for very long. For the looming PhD glut is not like a European butter mountain. Unlike the agricultural surpluses that pile up – and up and up – the science overhang is self-equilibrating phenomenon, and thereon hangs a story – or rather a myriad stories in the coming decade.

For the past few years a debate about science funding has raged in the scientific community between proponents of the entitlement view and adherents of the steady-state theory. It is now all but resolved.

Typical of the entitlement view is Leon Lederman, for a decade president of Rockefeller University, who argued in a

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Boston Globe
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The PhD glut is not like a butter mountain

controversial report to the American Academy for the Advancement of Science that science is "sick" because "every good scientist cannot "fulfill his destiny."

On the other hand, Robert White, president of the National Academy of Engineering, has chilly words for the story of the scrivener's apprentice. Having turned on a computerized machine for training scientists and engineers, we are unable to turn it off, he says, or even slow it down.

The truth is it is probably somewhere in between. Philip Griffiths, director of the Institute for Advanced Study, notes: "Our nation's commitment to scientific research has never been stronger, as demonstrated by President Bush's doubling the budget of the National Science Foundation."

There are more scientists and engineers doing basic research than ever before, Griffiths says. Academic R&D spending has increased 10 percent a year over the past 10 years, a rate comparable to the "golden era" of the Sputnik era. The Office of Technology assessment reckons that the federal government alone spent $21 billion on R&D in 1990.

The point is, the willingness to up the ante for more science and scientists is probably very nearly at its end. Therefore, don't look for a lot of new money to make work for highly trained specialists in the most remunerative lines of work. Even the most promising fields of inquiry – string theory, for example – are now probably grossly overstaffed.

Some people are trying to help ease the pain of the transition. US Secretary of State James A. Baker is peddling their weapons expertise to Third World nations. Clark Abt of the Boston University Center for the Study of Small States, is another example of a traditional entrepreneurial approach.

Abt, founder of the Cambridge contract research shop that bears his name, has been promoting the creation of an American-financed network of "innovation schools." He hopes to set up BU in a charming house, matching thoughtful American scientists to the needs of [illegible] nations, creating little [illegible] to study the scientific [illegible] nations as diverse as Latvia and Costa Rica.

"We want to see a wider range of options than all-out arms production and a reversion to low-grade computer goods. There are plenty of things to do besides making bombs and frying pans," says Abt.

But the most common response among scientists who are unable to find work in their fields will be to leave the laboratory and look for work in other fields. Press reports from Russia suggest that formerly top-flight scientists are providing a vital source of entrepreneurs looking to start up new businesses and to manage newly privatized state-owned operations.

The stereotype of blackboard-bound scientists as other-worldly nerds who cannot be expected to survive outside their disciplinary cloisters is probably hopelessly misleading. It won't be easy, but the creative energy of a crowd of bright and slightly desperate minds that would otherwise be employed proving another lemma or building another high-energy physics machine, entering commerce instead may be the real peace dividend, after all.

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NAFSA
ASSOCIATION OF
INTERNATIONAL
EDUCATORS

April 24, 1992

The Honorable Rick Boucher
Chairman,
Science Subcommittee
2319 Rayburn Building
Washington, DC 20515

Dear Representative Boucher:

As you know, NAFSA: Association of International Educators is a professional association providing information, training and other services to over 6500 individual members at 1800 institutions involved in international educational exchange. Thus NAFSA is deeply concerned by the introduction of the American Math and Science Student Support Act (HR 4595).

Although NAFSA, together with the rest of the higher education community, recognizes the importance of having more Americans pursue doctoral degrees, HR 4595 does not appear to be the most constructive use of limited resources to accomplish this goal. I understand HR 4595 will be the subject of a hearing before the subcommittee on April 29, 1992. I ask that the enclosed testimony be entered into the record of that hearing.

NAFSA Appreciates your consistent attention to international education issues and looks forward to participating in the discussion generated by HR 4595. Thank you in advance for your time and consideration. Please do not hesitate to contact me if you would like additional information.

Sincerely,

Lisa Jacobson Treacy
Staff Director, Government Relations

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STATEMENT BY
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BEFORE THE
SCIENCE SUBCOMMITTEE

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

ON HR 4595
THE AMERICAN MATH AND SCIENCE STUDENT SUPPORT ACT

APRIL 24, 1992

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44th NAFSA Annual Conference, Chicago, Illinois, May 24-27, 1992

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Introduction

The 1980s saw a general decline in the number of American students pursuing doctoral degrees, particularly in the fields of science, math, and engineering. Despite slight increases in the total number of doctorates awarded to Americans between 1989 and 1990, the numbers present a troubling picture of higher education in America.

NAFSA: Association of International Educators, a professional association providing training, information and other services to over 6500 individual members at 1800 institutions, shares the concerns of the higher education community about this issue, especially as it involves American minorities. Because many NAFSA members are professionally involved with promoting diversity within their institutions, NAFSA is well positioned to comment on the problems faced by both nonimmigrant aliens and American minorities on campus.

Despite active recruitment of American doctoral candidates, including minorities, on many NAFSA member campuses, the fact remains that there are not enough Americans pursuing doctoral degrees. We do not believe that HR 4595 constructively address this problem. Moreover, we disagree with the underlying premise of the bill: that increased scrutiny of graduate research assistantships will serve to help increase the number of Americans who receive doctoral degrees. Before detailing the precise reasons behind our opposition to HR 4595, however, we would like to place the issue of foreign students in a broader context and to provide a glimpse of how the convergent forces of science and technology and the international research and development community act to reduce the significance of national boundaries.

As part of the worldwide migration of scientific talent, foreign students represent a complex set of priorities and benefits for the student, the home country and the receiving country. These include the "push" of inadequate higher educational systems in the home country, lack of economic development and opportunity, and, not infrequently, the pressures of discriminatory political regimes. On the "pull" side are the attraction of more open and prosperous societies, the desire for personal skills and knowledge, and increasingly the need within the home country for specialized professional training. In the case of the United States, perhaps the strongest pull is the world class reputation of our post-secondary education system.

With the exception of France where the humanities still enroll the largest fraction of foreign students, all other major receiving countries (United States, Germany, Great Britain, Japan, Canada and Australia) report their predominant enrollments in either engineering and technology or business and management. The result is that many departments, if not entire educational institutions, benefit from, and in some cases, are highly dependent on, foreign student enrollments in these areas. In the more advanced industrial nations, where demographic trends have reduced the school age population and where the lure of high paying jobs have made prolonged graduate study unattractive to domestic students, foreign students fill the vacant places making it possible to sustain graduate programs that would otherwise be under-enrolled.

The responses to foreign students on the part of receiving countries are less consistent. The degree of welcome they receive is largely dependent upon the economic climate of the receiving country and its receptivity to immigrants of different racial or ethnic stock. In addition, countries where foreign student enrollments are the subject of definitive national policies, decisions are often based on the perceived cost benefit analysis of educating them, as well as the level of skills, wealth, and knowledge they are expected to bring with them.

Weighed against these benefits are the perceived competition between U.S. and foreign students for jobs and educational resources, and rising levels of cultural misapprehensions and antagonisms. The latter is particularly problematic when foreign student enrollments become large and visible, and when they are concentrated in certain fields.

How does the United States fit within this worldwide picture? With more than 400,00 foreign students enrolled last year, the United States is by far the largest "exporter" of higher education - with three times as many foreign students as France (the next highest "exporter"), five times as many as Great Britain, and ten times as many as Japan. Viewed as a percentage of the total student population, however, the numbers are less impressive. Foreign students compromise little more than 3% of the vast U.S. higher educational network, the lowest percentage of any major receiving country except Japan where the government has made increasing foreign student enrollment a priority. In France and Britain, by contrast, foreign students now constitute more than 10% of total higher education enrollments. They are almost 5% of total higher education enrollments in Australia, Canada and Germany.

Increasingly science and technology are blurring national boundaries. Foreign students, as a valuable part of the global research and development community, are an important part of this process. We believe that by discouraging U.S. academic institutions from hiring foreign students with federal funds, HR 4595 will have severely negative consequences in both the short and long run. Specifically, NAFSA believes:

The process proposed in the bill would impose a significant burden on academic departments and international offices yet would not necessarily encourage academic institutions to use Federal research funds for the support of American students.

In his March 26, 1992 statement in the Congressional Record Congressman Henry states, "as part of the R&D grant application process, universities would be required to report the name and country of origin of each non-immigrant alien they plan to hire as a research assistant under their federal grant proposal." Specifically, HR 4595 would require universities to keep track of the name and country of each nonimmigrant assistant, the intentions of each of these students with respect to seeking permanent residency, a description of the efforts the institution has made to hire U.S. citizens or permanent residents, and whether or not particular U.S. citizens or permanent residents were more or less qualified than the nonimmigrant students.

Although the language in the bill is not clear on when this report would be made, NAFSA understands that it is in fact the intention of the bill to make such a report part of the grant application process. This is impossible to do within the current Federal R&D grant application process because institutions do not, at the time of submitting the application, know whom they will hire as assistants.

Even if such information were required as part of the final grant report, as is now the case with the National Science Foundation, it would impose a significant paperwork burden on university departments, research offices and international offices already stretched thin by recent budget cuts. Because during the life of a research grant graduate students come and go, it is extremely cumbersome to maintain the kind of information specified in the bill.

Moreover, even if such a report were completed, one must ask the questions: What purpose would it serve? Who would read it? HR 4595, despite the best of intentions, would seem only to create additional paperwork that, while it would provide figures on students receiving funding, would not work toward solving the basic problems of which we are already well aware. At a time when President Bush is asking for a reduction in regulatory burdens and paperwork, HR 4595 seems to do just the opposite.

Regardless of whether nonimmigrants students return to their home countries or stay in the United States, the United States benefits from the presence of foreign students.

NAFSA fears that HR 4595 would ultimately act as a dis-incentive to hiring the most qualified applicants simply because of their immigration status. Forty-four percent of all international students are graduate students. International students not only contribute to valuable research endeavors in the United States, they also enrich the diversity and multiculturalism on American campuses. While in the United States, international graduate students contribute to important research projects and teach U.S. students. After they go home, these students become goodwill ambassadors for the United States. Furthermore, many graduate students are employed in U.S. corporations based in their home countries.

In addition, international students (both undergraduate and graduate) contribute a significant amount of money to the U.S. economy. Last year the Department of Commerce reported that international students brought more than $5 billion into the American economy. As a nation without a centralized system of education, the United States makes a very limited public financial contribution to the support of foreign students. Although the precise numbers are difficult to come by, Department of Commerce estimates that transfers to foreign students from private sources (including university assistantships derived from Federal grants) totalled 1.1 billion in 1991. Even when the amount of transfers from private sources is subtracted from $5 billion, the total - almost $4 billion - is significant. Moreover, America does not subsidize foreign students as France and Germany do, and state universities and colleges usually impose significantly higher tuition on foreign students as on out-of-state students in order to avoid subsidizing them.

An important part of this cost-benefit equation are the substantial indirect revenues that students can generate. These include the research and teaching they conduct as graduate students, the multiplier effect as some of that research is transferred into the economy, and the future economic value of those foreign students who provide a specialized professional labor pool for the country that educated them.

If international graduate students were discouraged from coming to U.S. institutions, it would create a vacuum that would not immediately be filled by U.S. citizens or permanent residents. In the short run this could force many departments to contract or even collapse. In the long run, this would negatively impact on U.S. economic competitiveness.

As noted at the beginning of our comments, the number of Americans pursuing doctoral degrees generally declined during the 1980s. Although international students represent only 20% of the total doctoral degree-seeking population, their presence is essential to the survival of some academic departments. Last year alone, over 50% of all Ph.Ds in math were awarded to international students. The reality is that without international graduate students enrolled in certain fields, academic departments, such as mathematics and the physical sciences, will shrink and may even be forced to close.

Interestingly, while the number of Americans obtaining doctoral degrees generally decreased during the last decade, certain minority groups have seen an increase. Between 1975-1990 Asian, Hispanic and Native American Ph.D. recipients doubled in absolute numbers during that time. The number of Ph.Ds obtained by African American women increased by 40% during that time.

American science and technology can only remain competitive by having access to the best and brightest talent available, regardless of the country of origin. Although many American graduate schools actively recruit for minority applicants to their graduate programs, the results of these efforts, assuming current rates of Ph.D. production, will not be felt for 6 -10 years. Across the board, American graduate

schools report considerable investment in recruiting U.S. minority students, while very little is being spent on international recruitment. Duke University, for example, focusses its annual graduate recruiting on historically black colleges and universities and on minority forums held in New York and California. Moreover, Duke does no overseas recruiting for international students.

Data from the National Research Council reinforce that the actual distribution of funding (federal or otherwise) does not break down along racial lines or places of origin.

According to a 1990 National Research Council report, 48% of all graduate students (both U.S. and foreign) received university support for their academic studies in all fields. Of this, 41% of U.S. students were funded versus 68% of international students. However, a closer look at specific fields reveals a different picture. In graduate schools of education, 12% of African Americans and 13% of white Americans received research assistantships. Twenty-seven percent of Asian American students received research assistantships in education and 28% of international students received funds. Although education is a field with a high percentage of minorities, similar patterns have developed in other graduate fields, including the physical sciences. Clearly, the issue of university funding cannot be broken down on foreign versus domestic lines. Colleges and universities offer research assistantships to the best qualified applicant at the time of the project.

When examining this issue, Congress must consider the support foreign governments give to nonimmigrant students in their own countries.

In Germany, American students pay no tuition. In 1983 Great Britain adopted the so called Pym Package which provides special tuition rates and expanded scholarship programs for students from favored nations -- usually Commonwealth countries or trade allies. It also developed scholarship programs such as the overseas Students Research Awards Program to attract the most talented graduate students from all over the globe. In 1990 Australia simplified its admissions policies instituting an Equity and merit Scholarship Scheme for needy and talented students from developing countries. Under this new program Australia's foreign student numbers have grown by 50% between 1990-91 alone. Japan has established a generous scholarship program offered by Monbusho (the Japanese ministry of Education) which supports about one sixth of the 44,000 foreign students enrolled currently.

Conclusion

The decline in interest in science and engineering among American students is a serious problem for which scholars and educators point to a number of causes. These range from poor preparation in math and science at the elementary and secondary levels, to the economic reality that Americans can get high paying jobs without a Ph.D. This problem, however, cannot and will not be solved if we begin at the doctoral level.

Educators agree that the underlying issues need to be addressed in early education, when Americans develop their academic interests, rather than at the graduate level after Americans have already completed 16 years of schooling. Congress should focus more on the quality of math and science education at earlier stages in the educational process so that when U.S. students reach the doctoral level they will be better able to compete with their fellow students. In the meantime, international students, academic departments, and valuable research projects should not be penalized because of structural problems within the U.S. educational system.

The United States must keep competitive with other countries if we hope to keep attracting the best minds in the world to our colleges and universities. In the short run, academic departments should not be faced with the prospect of research endeavors coming to a halt, nor possibly being forced to close -- both of which would have extremely negative effects on academia in the United States. In the long term, the health of the U.S. economy depends on increasing the supply of top notch young American scholars. Discriminating against foreign students is not the solution.

National Association
of State Universities
and Land-Grant Colleges

April 29, 1992

The Honorable Rick Boucher
Chairman, Subcommittee on Science
Committee on Science, Space and Technology
2319 Rayburn House Office Building
U.S. House of Representatives
Washington, DC 20515-4609

Dear Congressman Boucher:

This concerns H.R. 4595. Although the National Association of State Universities and Land-Grant Colleges (NASULGC) did not participate in preparing the testimony submitted by the Council of Graduate Schools (CGS), we support their opposition to the bill and their essential arguments. I wish to communicate the following additional views:

(1) There is a national need to expand the number of American professionals, especially at the doctoral level, in mathematics and science. This needs to be promoted for all U.S. citizens including, very especially, the minority population.

(2) But, despite the commendable objective of H.R. 4595, the method proposed does not address the underlying cause of the problem and would create a costly and burdensome bureaucratic process in our nation's universities and graduate schools.

As a consequence, NASULGC opposes this bill, even as we are eager to work with the many persons concerned with increasing the admission--and the awarding of doctoral degrees--to U.S. citizens.

Cordially,

C. Peter Magrath
President

cc: Jules Lapidus, President, Council of Graduate Schools
Robert Rosenzweig, President, Association of American Universities

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